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# STOCHASTIC DISTURBANCE DATA FOR FLIGHT CONTROL SYSTEM ANALYSIS

TECHNICAL DOCUMENTARY REPORT NO. ASD-TDR-62-347

September 1962

Directorate of Aeromechanics
Aeronautical Systems Division
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

Project No. 8219, Task No. 821904

(Prepared under Contract No. AF 33(616)-8088
by Lockheed-Georgia Company, Marietta, Georgia;
John E. Hart, Lowry A. Adkins, Larry L. Lacau, Authors)

Aeronautical Systems Division, Dir/Aeromechanics, Flight Control Lab, Wright-Patterson AFB, Ohio.
Rpt No. ASD-TDR-62-347. STOCHASTIC DISTURBANCE DATA FOR FLIGHT CONTROL SYSTEM ANALYSIS. Final report, Sept 62, 254p. incl illus., tables, 147 refs.

Unclassified Report

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( over )

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## FOREWORD

The research program under which this report was compiled was initiated by Mr. Ronald O. Anderson, Chief of Systems Optimization Section, Aero Space Mechanics Branch of the Flight Control Laboratory, Aeronautical Systems Division of the Air Force Systems Command, Wright Patterson Air Force Base, Ohio. This report represents work done by Lockheed-Georgia Company in a study entitled, "Research on Stochastic Disturbance Data for Use in Flight Control System Analysis," under Air Force Contract AF 33(616)-8088, Project 8219, "Stability and Control Investigations," Task 821904, "Flight Control Systems Analysis and Optimization."

Gratitude is extended to Mr. Anderson for the useful data, invaluable guidance, and cooperation which he contributed throughout the program. Acknowledgment is also made to the various individuals, government agencies, academic institutions, airframe, and engine manufacturers who made valuable contributions to the data presented in the report.

The author and engineer with direct cognizance over the program was Mr. J. E. Hart, Group Engineer, in the Lockheed Mechanical & Hydraulics Systems Engineering Department. Major contributions to the study were made by Messrs. L. A. Adkins and L. L. Lacau of the same department. Also contributing to the presentation of the various data were Messrs. F. E. Courtney, J. A. Osterman, and F. P. Holder, all of Lockheed-Georgia Company

# ABSTRACT

Disturbance data, together with guidance signals, are needed to perform realistic analyses of flight control systems. Stochastic disturbances, which are by definition defined only in a statistical sense, have not previously been compiled and codified for use in such analyses. The stochastic data included in this report cover the subjects of winds, wind shear, gusts, magnetic fields, solar radiation, vibration and acoustics, meteors, thrust irregularities, and sensor noise. Areas of these subjects in which needed data are lacking have been exposed by the study. Present programs of data accumulation cited and the recommended new programs will produce significant information required to supplement the data of this report. A table of earth magnetic field intensities is included as an appendix.

## PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

Charles B. Westbrook

CHARLES B. WESTBROOK
Chief, Aerospace Mechanics Branch
Flight Control Laboratory

## TABLE OF CONTENTS

## LIST OF ILLUSTRATIONS

| Figure | | Page |
|---|---|---|
| GUSTS | | |
| 20 | Horizontal and Vertical Gust Relationship | 46 |
| 21 | Gust Factors | 48 |
| 22 | Cumulative Gust Frequency Per Mile of Flight | 51 |
| 23 | Variation in Thickness for Areas of Non-thunderstorm Turbulence | 53 |
| 24 | Gust Velocity as a Function of Gust-Gradient Distance | 55 |
| 25 | Nonthunderstorm Gust Probability of Occurrance | 56 |
| 26 | Thunderstorm Gust Probability of Occurrence | 57 |
| 27 | Average Gust Velocity Probability of Occurrence | 59 |
| 28 | Analytical and Measured Gust Power Spectra Data | 65 |
| 29 | Cumulative Probability Distributions of Root-Mean-Square Gust Velocity | 66 |
| 30 | Normalized Amplitude Curves | 69 |
| 31 | Frequency Content of 1-cos Impulse | 71 |
| THRUST IRREGULARITIES | | |
| 32 | Thrust Characteristics of Solid Propellant Motor for Various Propellant Temperatures | 80 |
| 33 | Thrust Percent Variation Power Spectrum | 81 |
| 34 | Thrust-Time Curves Comparison | 83 |
| ACOUSTICAL VIBRATION | | |
| 35 | External Sound Pressure Levels at Lift-Off | 87 |
| 36 | Nose Cone Noise from Rocket Engines | 89 |
| 37 | Internal Sound Spectra at Constant q for Various Mach Numbers | 90 |
| 38 | Overall Sound Pressure Level vs Fuselage Station for Vehicle of Reference 8 | 92 |

## LIST OF TABLES

# I INTRODUCTION

Methods of analysis of flight control systems have been refined to such a degree that the response of a vehicle-control system combination to specified inputs may be accurately described. Knowledge of the form of actual inputs, however, has not progressed so rapidly. Inputs consist of a combination of command or guidance signals, which direct the flight path; and disturbances, which either force the vehicle from its desired path or attitude or generate false command signals. Disturbances which exist may be considered as non-stochastic or stochastic with the latter generally being considered as those disturbances which are known only in a statistical sense. The purpose of this report is to compile and code stochastic disturbance data for use in the analysis of flight control systems. A comparable program in the area of command and guidance signals would supplement the data of this report to afford a relatively complete definition of actual control system inputs.

Disturbances which are readily determinable, such as the force of the gravitational field, are not included in this study. On the other hand, the magnitude and direction of the geomagnetic field, which is determinable, is included in the program because of the limited availability of this information for the higher altitudes. The range of altitudes for which data are given is from sea level to 1,000 miles. No limits are assumed on the type of vehicles to which the disturbances apply; however, use of the data in control system analysis limits the dynamic frequency range considered to a maximum of about 60 radians per second.

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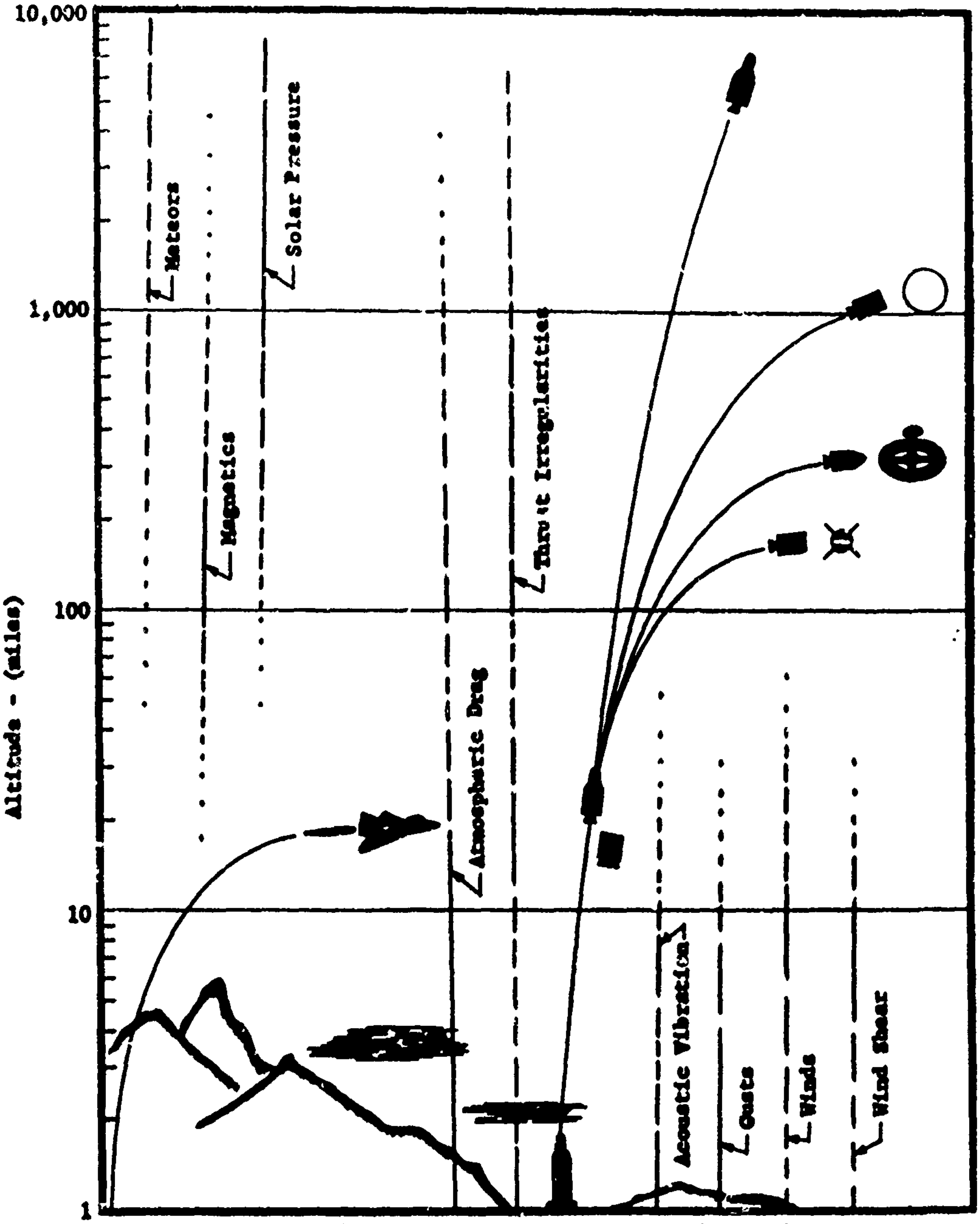
## II DATA APPLICATION

The relative importance of the several disturbances covered in this report varies as a function of vehicle design, altitude, speed, and other factors. To a hovering VTOL aircraft, for example, the effect of solar pressure is negligible; but winds, wind shear, and gusts are of paramount importance. A large, nonmetallic satellite orbiting at an altitude above five hundred miles is greatly influenced by solar pressure; a metal satellite orbiting at the same altitude may be most significantly affected by magnetic disturbances. From these considerations, it is evident that only general indications can be given as to which disturbances should be considered in analyzing any particular flight control systems.

Representations of the relative importance of the various disturbances are made in Figures 1 and 2, where the independent variable of altitude is plotted as the ordinate. Vehicles and their typical operations are also inferred pictorially in Figure 1. Some disturbances are seen to influence vehicles only when they are operating within the atmosphere; others influence vehicles only when they are in orbit or on escape paths. It may be seen from these figures that there are altitudes where the sum of all disturbances is large and others where the total disturbance is relatively small. It must be kept in mind that the degree of severity of any disturbance depends upon the vehicle's susceptibility and its ability to recover from the effect.

The specific manner in which the data are applied to the analysis of flight control systems is a complex subject. In most cases, the first concern in control system design is that of avoiding unacceptable performance, viz., divergent oscillations or catastrophic upset conditions. By considering the statistics of the disturbance intensities, this requirement can usually be met, and is frequently found to establish the maximum control power requirement or rate of build-up of control torque. Beyond this basic consideration, however, there are numerous criteria for control system design. Power spectrum densities of gusts are required to analyze performance as related to structural fatigue analyses. Simple statistical data on wind intensities are needed to predict the probable off-set of the path of a vehicle when there is no path translation correction. For commercial vehicles, the damping and frequency of pitch oscillations induced by disturbances may be governed on the basis of passenger comfort.

Non-stochastic disturbances, such as fuel slosh or body bending, can be included in the analysis of a flight control system by simply adding the analytical formulations to the vehicle-control system matrix. (This is not to imply that such formulations and associated coupling terms are well established, but only that the manner of including such disturbances is known.) Stochastic disturbances, which are the subject of this report, will generally be included in the system analysis in the form of independent excitations. In any event, the use of mathematical analysis techniques




**NOTE:** Quality of disturbance lines signifies relative importance
high <———— —— — - - - -> low

Figure 1. Areas of Applicability of Stochastic Disturbances.

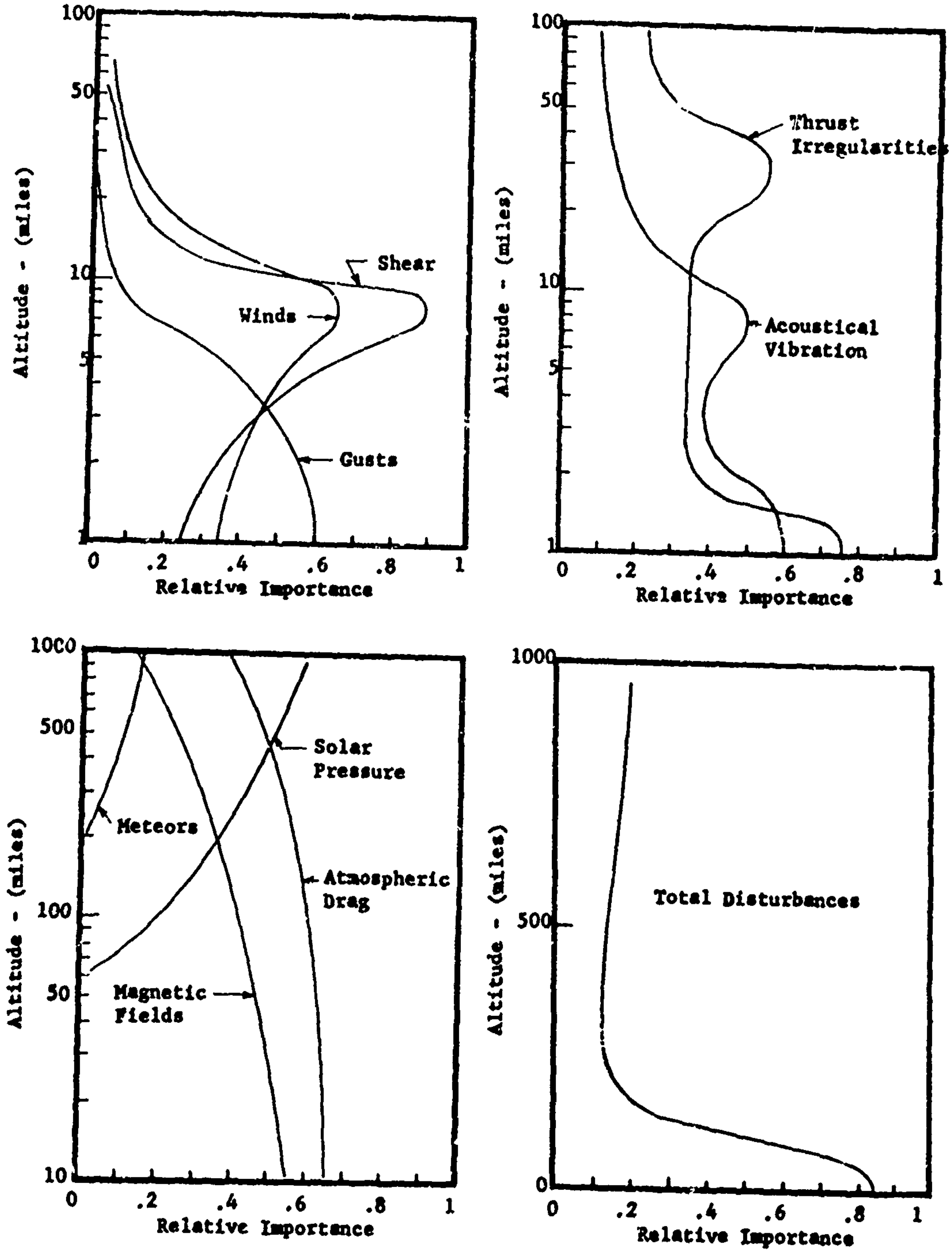



Figure 2. Relative Importance of Disturbances with Altitude.

suggest that the definition of disturbances be given as analytical functions of time or as power density spectra. Ideally all stochastic disturbances producing the same effect, e.g. upsetting torques, would be expressible by a single function. This goal, and even that of expressing each of the individual disturbances in this fashion, will require considerable further work.

Where possible, the data given in this report are expressed in analytical form, but in many cases the non-analytical form of the data will require that they be injected into the analysis as discrete impulses at arbitrary (possibly critical) times. There is a notable lack of information on the relative importance of the several disturbances covered in this report. Because of this a worst-on-worst addition of the effects of disturbances may have to be assumed as a practical possibility. Certainly this is an area for further investigation.

## III DISTURBANCE DATA

### BACKGROUND INFORMATION

Selection of the disturbances which are included in this study was made, in conjunction with the Project Engineer, on the basis of several considerations. Only those disturbances which are considered stochastic are included, with the single exception of disturbances due to magnetic fields. The selection is also limited to those disturbances which exert a measurable influence on the flight control system over some portion of the pertinent altitude range.

The data contained in this report were obtained from an extensive literature search, from unpublished results of studies at the Lockheed-Georgia Company, and from correspondence and conversations with various university, governmental, and industrial authorities. Every effort has been made to report only those data which have been verified. In some cases where conflicting data existed and it was not possible to corroborate either result, this fact is either noted or the data omitted entirely. Data were extracted directly from some synoptic references and from references which presented information in uniquely useful forms. A few general comments on the data contained in the remainder of the report are as follows:

Wind, wind shear, and gust data possibly form the most important group of stochastic disturbance information. The probable intensities of these disturbances for various geographical locations, altitudes and times are presented in some detail; but analytical expressions, which may be used directly in analysis, are presented only for the gusts. Information on anomalies such as the low altitude jet streams is reported even though the statistical probability of occurrence or intensity is not known.

Main and control motor thrust irregularities, which produce the primary disturbance to some vehicles during certain phases of flight, are not well documented. The limited information which is available indicates that the influence of numerous parameters must be considered. The fact that the source of the thrust irregularities is largely a characteristic of the motor design permits the establishment of statistical information from a test program on similar production samples. Prediction of the magnitude of thrust irregularities for a given motor prior to its production will require significant advances in design information.

Vibration and acoustical disturbances also originate in conjunction with the motor and vehicle design but are more amenable to analysis and prediction. The data presented on this subject indicate the relative influence of the type of motor and its thrust level, and the variation of intensity and frequency spectrum with location. Tests on the specific vehicle will generally be required, however, to obtain more accurate data when a critical condition is indicated.

Data on the intensity and direction of the fixed magnetic fields about the earth are given in detailed and accurate form. Small variations occur in the field; but they are too sporadic to have their frequency excitation qualities defined, and their magnitudes are generally so small that they

may be neglected. Variations in solar radiation and the related high altitude atmospheric density variations are presented in considerable detail. Previously unpublished analytical expressions for altitude densities are included which permit relatively accurate calculations of drag variations. The magnetic, solar radiation, and atmospheric drag data, together with the less important information on meteors, permits the calculation of all significant stochastic, external disturbances on satellites.

The subject of sensor noise is discussed briefly to indicate the areas in which this internal disturbance may be important in various vehicles. Presentation of detailed data on the intensity and nature of sensor noise, even limiting consideration to the major sensors and related systems, would require an extensive program of itself.

WINDS

Tabulations of the average winds which exist at various locations and times are of limited value in control system analysis since they give no indication of probable maximum values. Extremes of wind velocities which have been recorded for a given location impose excessive control requirements if assumed for design values. For these reasons the material in this report was prepared for several different probabilities of occurrence* which were felt to be most representative of the requirements for vehicle control system analysis. As an additional factor in establishing the probabilities of occurrence of specific wind conditions, the probabilities were considered on the basis of the season of maximum speed and shear (generally the winter season), thus insuring higher likelihood of a successful flight during the other seasons of the year.

Frequently the wind profile, or magnitude of wind as a function of altitude, is of interest. Designating the criterion upon which the severity of a wind profile can be judged, however, is not a simple task. The wind speed at the level of maximum winds (30,000 to 45,000 feet in the winter in temperate latitudes) can approach 340 fps as a 1 percent extreme; whereas, the 1 percent surface winds are generally only about 50 fps. An integrated value of the change in wind speed with altitude (the shear) from the ground to the maximum wind level is represented by the speed at the peak of the wind profile, since the surface wind is generally an order of magnitude less than the speed at the maximum wind level. Thus, the maximum speed of the wind profile is a good first approximation of its integrated severity from the ground to the level of maximum wind speed.

The altitude to which the wind structure is important is another consideration. Extremely strong winds and shears are known to exist at 200,000 to 400,000 feet (1)**. However, the density of air at these altitudes is such that winds can create little force on a vehicle. A plot of wind speed versus altitude for various q values, with the 1 percent wind profile superimposed, is shown in Figure 3. A vacuum trajectory is often assumed in ballistic calculations above 250,000 feet (2). Past investigators (1, 3, 4) have indicated that winds in the lower 100,000 feet warrant detailed consideration and are especially important in the 30,000 to 40,000 feet range. They have also indicated that they were interested in a design philosophy which would allow an optimum design wind profile. For example, if a missile must be able to operate from any location in the United States and at all times, one might consider a wind profile with a probability of 1 percent for the Middle Atlantic Seaboard winter where upper air charts indicate that the strongest winds occur.

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*Probability of occurrence levels are defined as the cumulative percentage frequencies associated with data arranged in order of decreasing magnitude. These frequencies (levels) represent that percent of the total data exceeding a certain magnitude.

**Numbers in parentheses denote references at the end of the subsection.

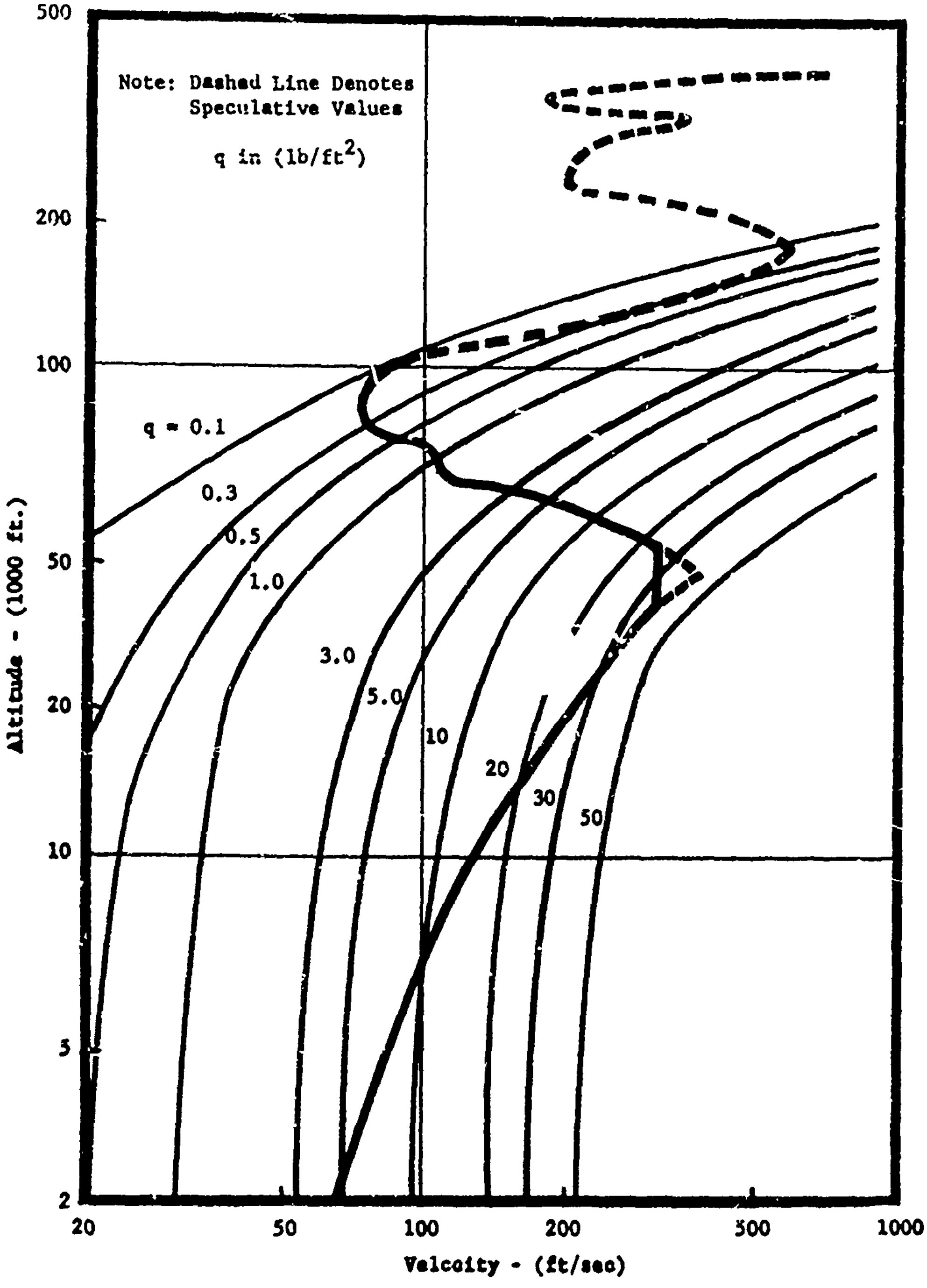


Figure 3. 1% Wind Speed Profile as Related to Altitude & q

Accurate data on wind characteristics representative of all important areas and altitudes is at present merely a goal. The data which exist are for a very few selective areas and not always accurate to the degree that is necessary for valid design criteria. Generally it can be said that the prevailing winds in the middle latitudes of the northern hemisphere are westerly, i.e. from the west, increase in speed from the surface to the tropopause (30,000 to 40,000 feet), and then decreases with height to about 80,000 feet. They again increase in speed above 80,000 feet remaining westerly in the winter and becoming easterly in the summer.

A plot of average wind speed and direction for the middle latitudes in the northern hemisphere (5) is presented in Figure 4. Since the curve, as plotted, is in terms of average wind velocity, its usefulness is confined to merely presenting the picture of the general wind structure. More exact wind speed values, including some specific probability of occurrence, are included in the following paragraphs.

The altitude of reversible winds is approximately 60,000 to 80,000 feet and the change-over from west to east winds above this altitude occurs suddenly near the vernal equinox* (sometimes as much as a month before or after). The return to westerlies again is sudden near the time of the autumnal equinox.** Near the equinoxes the winds above 60,000 feet will vary as much as 180° in direction from day to day until such time as a steady monsoon is established again.

It might be well to mention here the geotropic and thermal wind equations from Jenkins (6) to show theoretically how an upper-level wind is composed. The wind near the surface of the earth is directed so that lower pressure is to the left and higher pressure to the right as one moves with the wind. This motion comes about as a balance of the pressure gradient force, which causes a flow from high pressure to low pressure, and the Coriolis force, or deflecting force of the earth's rotation. The Coriolis force acts to the right of the wind in the northern hemisphere and to the left in the southern hemisphere so that it in fact works in opposition to the pressure gradient force. The wind flow near the surface thus quite nearly parallels the lines of constant pressure and its speed is dependent upon the magnitude of the pressure gradient. The speed of the wind at the middle latitudes, when straight line flow exists, is given by the geotropic wind equations:

$$u = \frac{1}{2\,\omega\rho\,\sin\phi}\;\frac{\partial P}{\partial Y} \quad \text{and} \quad v = \frac{1}{2\,\omega\rho\,\sin\phi}\;\frac{\partial P}{\partial X}$$

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* = About March 21

** = About September 22

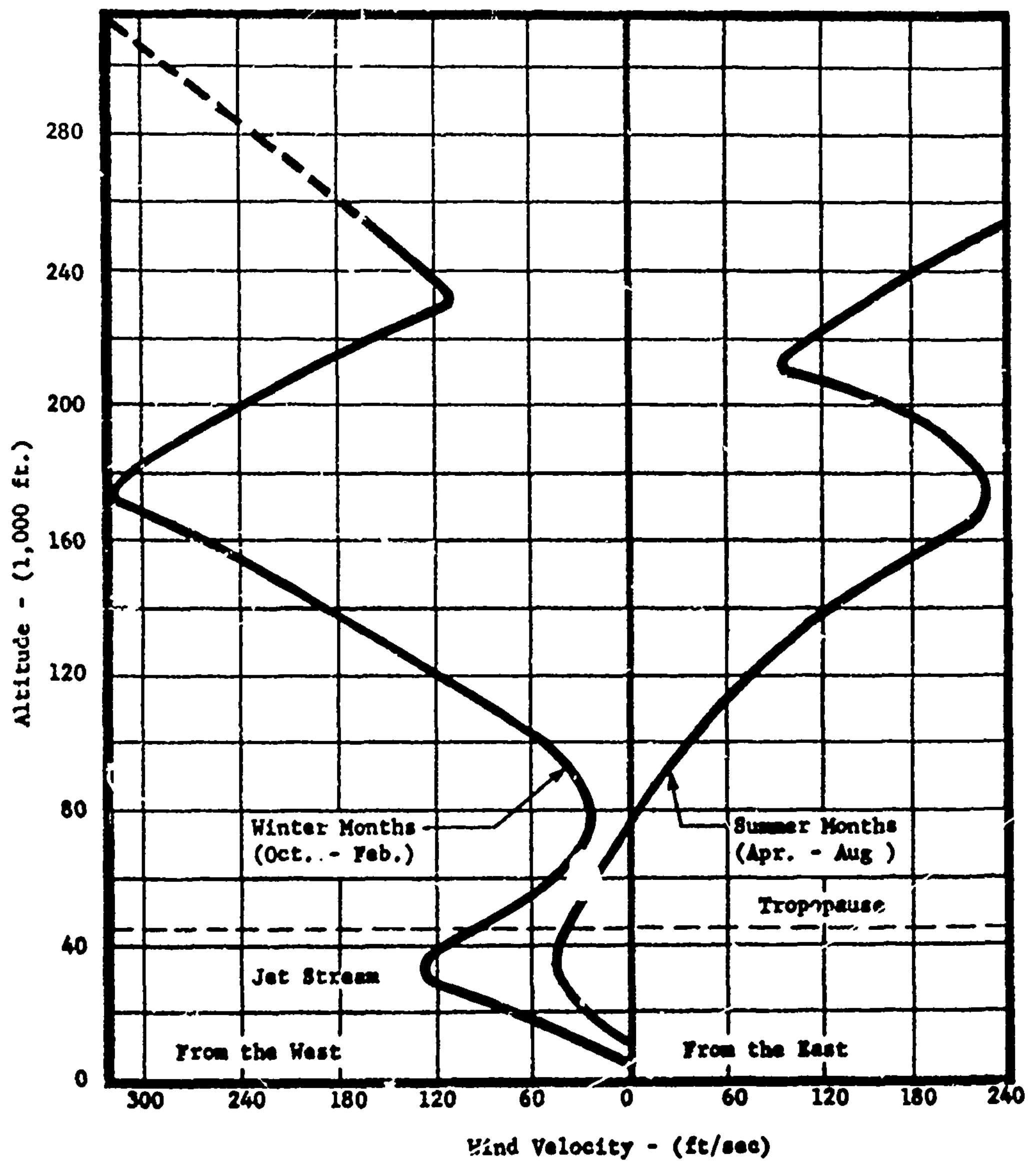



Figure 4. Average General Wind Profile

Where: $u$ = wind speed in the east-west direction (ft/sec)

$v$ = wind speed in the north-south direction (ft/sec)

$\omega$ = angular velocity of the earth's rotation (rad/sec)

$\Phi$ = latitude (deg)

$\rho$ = mass density of the air $\left( \frac{\text{lb-sec}^2}{\text{ft}^4} \right)$

$\frac{\partial P}{\partial X}$ = pressure gradient in the east-west direction $\left( \frac{\text{lb}}{\text{ft}^3} \right)$

$\frac{\partial P}{\partial Y}$ = pressure gradient in the north-south direction $\left( \frac{\text{lb}}{\text{ft}^3} \right)$

And let $Z$ = altitude (ft)

$T$ = temperature (°R)

$R$ = gas constant of air (1545)

Subscript (o) denotes the initial condition or the condition at the surface of the earth.

By the universal gas law for air, $P = \rho RT$; and the relation of air density with respect to altitude, $\rho = -\frac{1}{g}\frac{\partial P}{\partial Z}$; and the geotropic wind equations, assuming the mass density of air is constant at a given altitude, the east-west and north-south components of a wind at the altitude $Z$ can be expressed respectively as follows:

$$u = u_o + \frac{g}{2\omega \sin \Phi} \left\{ \int_{Z_o}^{Z} \frac{1}{T}\frac{\partial T}{\partial Y} dZ + \int_{T_o}^{T} \frac{R}{gT}\frac{\partial T}{\partial Y} dT \right\}$$

$$v = v_o + \frac{g}{2\omega \sin \Phi} \left\{ \int_{Z_o}^{Z} \frac{1}{T}\frac{\partial T}{\partial X} dZ + \int_{T_o}^{T} \frac{R}{gT}\frac{\partial T}{\partial X} dT \right\}$$

In most cases, the range of temperature variation is very small when compared to the range of altitude in above equations. For practical purposes, the wind speed components in the east-west and north-south directions can be written respectively as:

$$u = u_o + \frac{g}{2\omega \sin \Phi} \int_{Z_o}^{Z} \frac{1}{T}\frac{\partial T}{\partial Y} dZ$$

$$v = v_o + \frac{g}{2\omega \sin \Phi} \int_{Z_o}^{Z} \frac{1}{T}\frac{\partial T}{\partial X} dZ$$

where:

$\frac{\partial T}{\partial X}$ = temperature gradient in x direction (°R/ft)

$\frac{\partial T}{\partial Y}$ = temperature gradient in y direction (°R/ft)

Thus by changing the pressure gradient aloft, the temperature controls the change in wind with altitude. This wind effect is called the "thermal wind." At any level in the atmosphere, the total wind is a vector sum of the surface wind and the thermal wind. When the direction of lower pressure and lower temperature are the same, the wind increases with altitude. When the direction of lower pressure and higher temperature are the same, the wind decreases with altitude.

In the middle latitudes in winter, the normal condition is that both lower pressure and lower temperatures are to the north and so the winds increase with altitude up to about 30,000 - 40,000 feet. Above this level the temperature gradient generally reverses. The wind decreases in strength somewhat up to 60,000 to 80,000 feet, but remains westerly as the temperature reversal is not strong enough to reverse the flow. In summer, however, it appears that there is enough absorption of solar radiation in the higher latitudes at levels above 40,000 feet to cause the wind to reverse to easterlies by the time 60,000 feet is reached. This is due to a strong reversal in the temperature fields at these levels. Evidence that the temperature above 60,000 feet in the northern part of the middle latitude zone is much higher in summer than at stations closer to the equator, is shown by radio soundings taken in England during the summer months and by the sound propogation studies in Alaska (7). Since ozone shows an increase in amount with an increase in latitude and is a strong absorber of solar radiation, it undoubtedly plays a part in the temperature reversal; and in turn, the wind reversal with seasons. Until further data are available from the Southern Hemisphere, it is assumed that the wind patterns are similar to the Northern Hemisphere except that the flow picture is reversed.

The curves of Figure 5 (1) show several typical vertical distributions of wind speed for the altitude range where direct observations are generally available.

The strongest winds in the middle latitudes are concentrated into a narrow core which, more or less, encircles the earth (1). The core is often referred to as "the jet stream." It oscillates at least 5 to 10 degrees of latitude around its mean yearly position which is roughly 35°N latitude. From Figure 6, it can be seen that the eastern part of the country is under the influence of the strongest winds in January. The jet stream is sometimes referred to as a separate entity, such as a tornado that can be avoided. This is misleading since "jet stream" is used to describe all strong "rivers of air" that may exist at any location at any given time. If it is postulated, for example, that a particular design must not be limited by high winds, except on 1 percent of the days in the winter, then all wind data must be considered and jet stream wind statistics must not be artificially segregated.

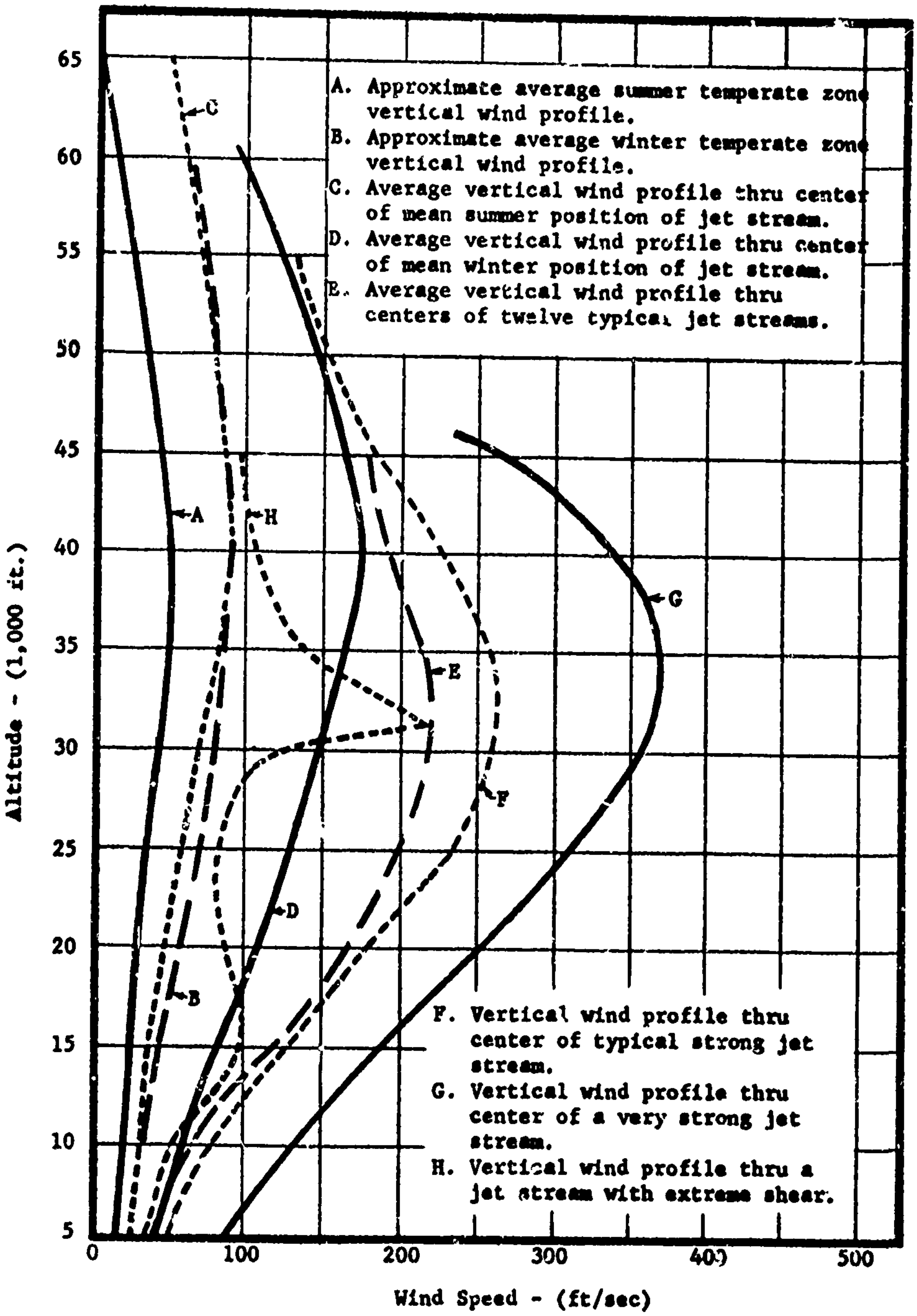
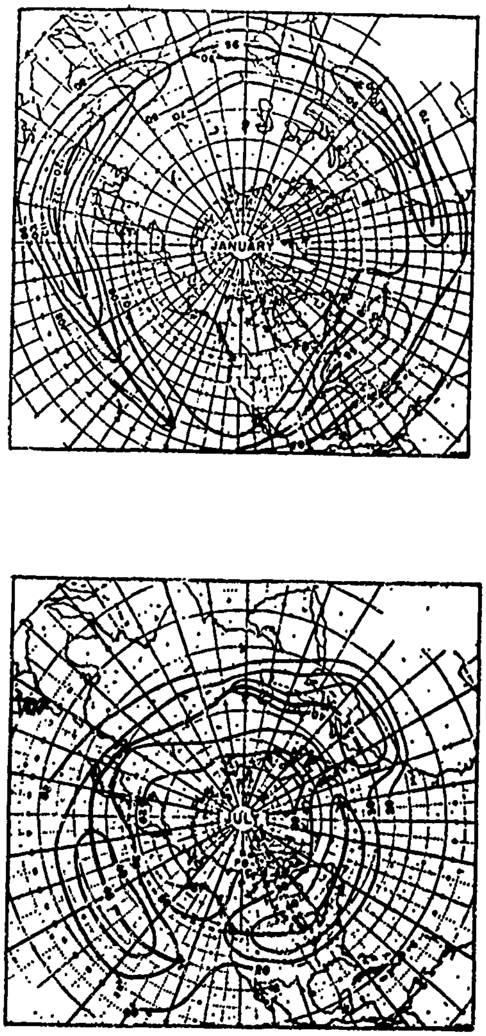



Figure 5. Typical Wind Speed Profiles




Average position and strength of the jet stream are shown with heavy solid lines indicating geostrophic wind speed in miles per hour at the level of maximum speed. Heavy arrows represent center of jet.

Figure 6. Average Jet Stream Locations

An interesting aspect of the wind phenomenon of the jet stream type (9) discovered in recent years, is the low altitude, high velocity wind streams that are found predominately over the western and plain states. These jet stream type air currents have magnitudes of 70 to 120 fps at their peaks and are usually found at an altitude of 1,000 to 2,000 feet above terrain. For several years prior to their measurement, the existence of the streams was suspected; but it was not until 1953 that streams were actually measured. At present, the general features of the low-level stream are fairly well known. On days when it occurs, it begins to build up in late afternoon, reaches its maximum in the middle of the night, and decays in the early morning. A set of profiles indicating the build up and decay of a typical low level jet stream is shown in Figure 7. At their peak the winds in its core between 800 and 2,000 feet up, can attain between 70 and 120 fps, decreasing to 15 to 30 fps both at the ground and between 3,000 and 4,000 feet above the ground. Unlike the much faster high altitude jet stream that girdles the earth at about 30,000 feet, the low-level stream is essentially a local phenomenon. Nevertheless, it can sometimes be 1,000 miles long and anywhere from 50 to 500 miles wide. It probably forms occasionally in most regions of North America, but is most common over the flat terrain of the Great Plains, and it is least likely to be found in hilly or mountainous areas. The references on low-level jet streams gave no reasons why the stream could not occur anywhere in the world. Since it does occur at such low altitudes with corresponding high q values, its presence and the high shear values associated with it could be significant design considerations.

Statistical data on the probable magnitude of winds at various altitudes are available for a limited number of specific locations, and usually are excellent in detail for these particular areas; however, probable wind magnitudes on a global scale are lacking. Until radar wind sounding became available in about 1944 there were few strong winds aloft recorded because sounding balloons, followed visually with theodolites, were generally blown out of sight as the wind speed increased at higher altitudes or the balloons could not be observed at these higher altitudes due to clouds (1). Even today, with radar equipment, many high wind speeds cannot be observed because of tracking radar blockage by the horizon at the great distance that the balloon borne radar targets are carried in these winds. Earlier techniques became unreliable when this angle went below 14°, with later equipment being reliable to about 6°. These angles are common for average speed differentials from the surface to the balloon height of about 70 fps for the older and about 160 fps for the newer equipment. However, lower speeds in the low levels permit better observations of the strong high altitude winds (These speeds apply to normal balloon rates of ascent of 1,000 ft/min.). Winds of 840 fps have been reported at the 30,000 to 40,000 foot level over Japan (1), where the targets are often released upstream and tracked by a series of stations to prevent low vertical angles. Wind speed can also be deduced mathematically from the spacing between height contours on meteorological, constant pressure charts (1). Even though statistical analyses of this particular type are not available for many locations, this information is closely approached at upper levels in a study of the vector mean wind and the standard vector deviation of winds up to 50,000 feet, by C.E.P. Brooks (11).

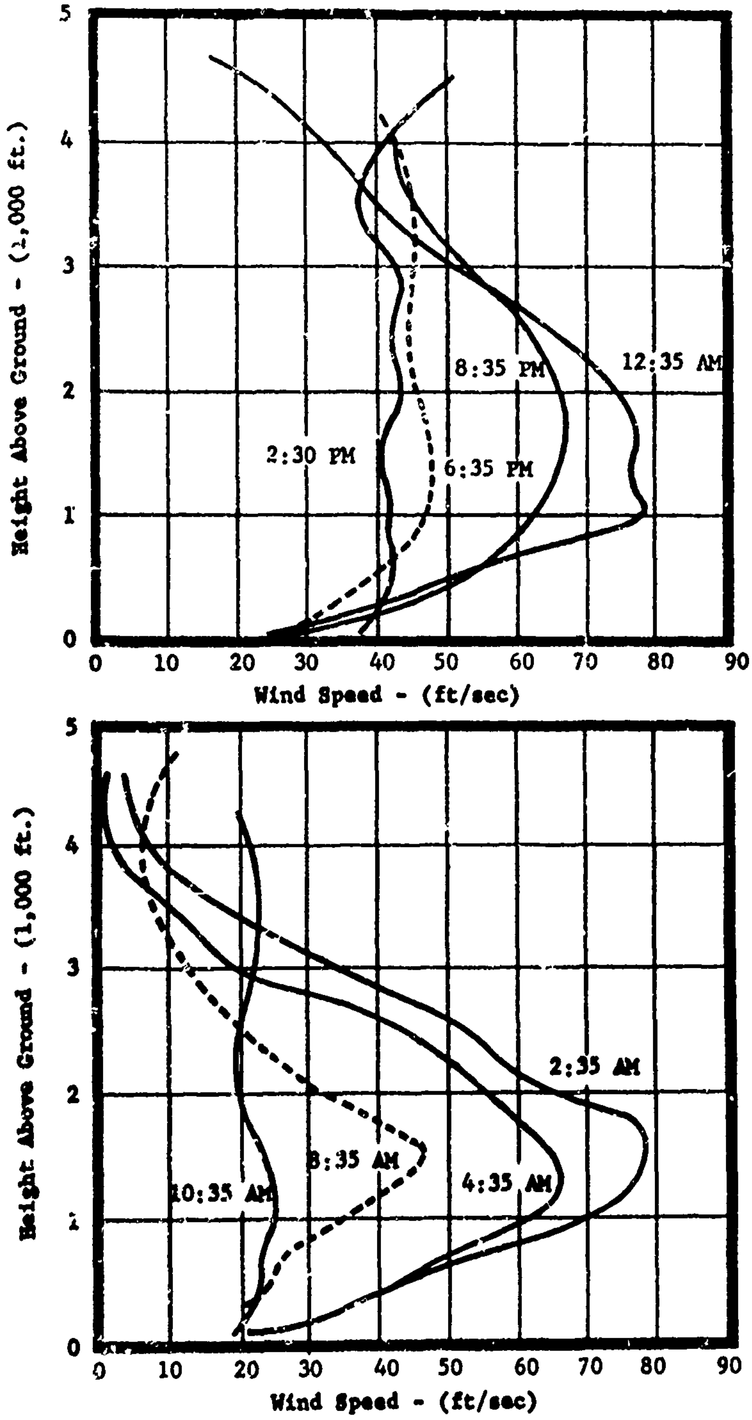



Figure 7. A Typical Low Level Jet Stream

Wind flows are determined by many means (6), with the following list giving a few of the more useful techniques and their range of application:

1. Balloons - tracked by radar, theodolites and radio . . . . . . . . . . . . up to 120,000 ft.
2. Smoke puffs from shells and rockets . . . . up to 400,000 ft.
3. Sound propagation of explosives . . . . . . up to 170,000 ft.
4. Radar measurements on ionization columns . . . . . . . . . . . . . . . . . . 250,000 to 350,000 ft.
5. Radio measurements of sporadic E cloud movements . . . . . . . . . . . . . . . 250,000 to 400,000 ft.

Of the above mentioned methods the bulk of the data on record is in the range up to 120,000 feet and gathered by the balloon (12) method. The sound (13) and smoke (14) methods for the 100,000 to 250,000 foot levels seem to agree quite well with each other and are in fair agreement with radiosonde data.

There is a large gap in wind data between 160,000 and 250,000 feet with the only source of data to these altitudes being from rocket flights. A few measurements have been made at White Sands, New Mexico (6) and Wallops Island, Virginia (15). Other tests are currently being made at Eglin AFB in Florida by Dr. Howard D. Edwards of the Georgia Institute of Technology. The tests at Eglin, being performed to develop a clearer picture of winds in the 200,000 to 400,000 foot altitude range, use high altitude sounding rockets containing cesium and sodium charges which produce a vapor cloud when exploded at the desired altitude. The clouds are then tracked visually and their relative movements established by triangulation methods. The charges can also be exploded in a series at progressing altitudes to determine the relative wind conditions at different altitudes. At present the data from these experiments are still in rough form. From a preliminary analysis Figure 8 was constructed by plotting actual data points then forming a smooth approximate curve through the points. The curve shows a good continuation of Figure 4 for the winter months, and also a reasonably close continuation of the summer season curve. According to Dr. Edwards, the wind data he has compiled from his experiments seem to be in close accord with data from the same altitude range taken by the same and other methods at other locations over the globe, which supports his theory of global similarity for winds in this altitude range. He also postulates from his data, and the other similar data, that the wind field in the upper stratosphere is to a high degree independent of both the lower level wind field and the terrain beneath. The component of the wind at any high stratosphere level which is contributed by the surface wind is only a small fraction of the total. The major factor is the thermal wind through the layer. The thermal factors of the earth's surface, e.g., temperature difference of land and ocean, are not as important as the absorption of solar radiation in the high levels. There are many factors in the absorption picture which are unknown as yet, such as water vapor content and exact ozone distribution in the horizontal and vertical. These factors must be studied further before much more can be deduced about the wind field.

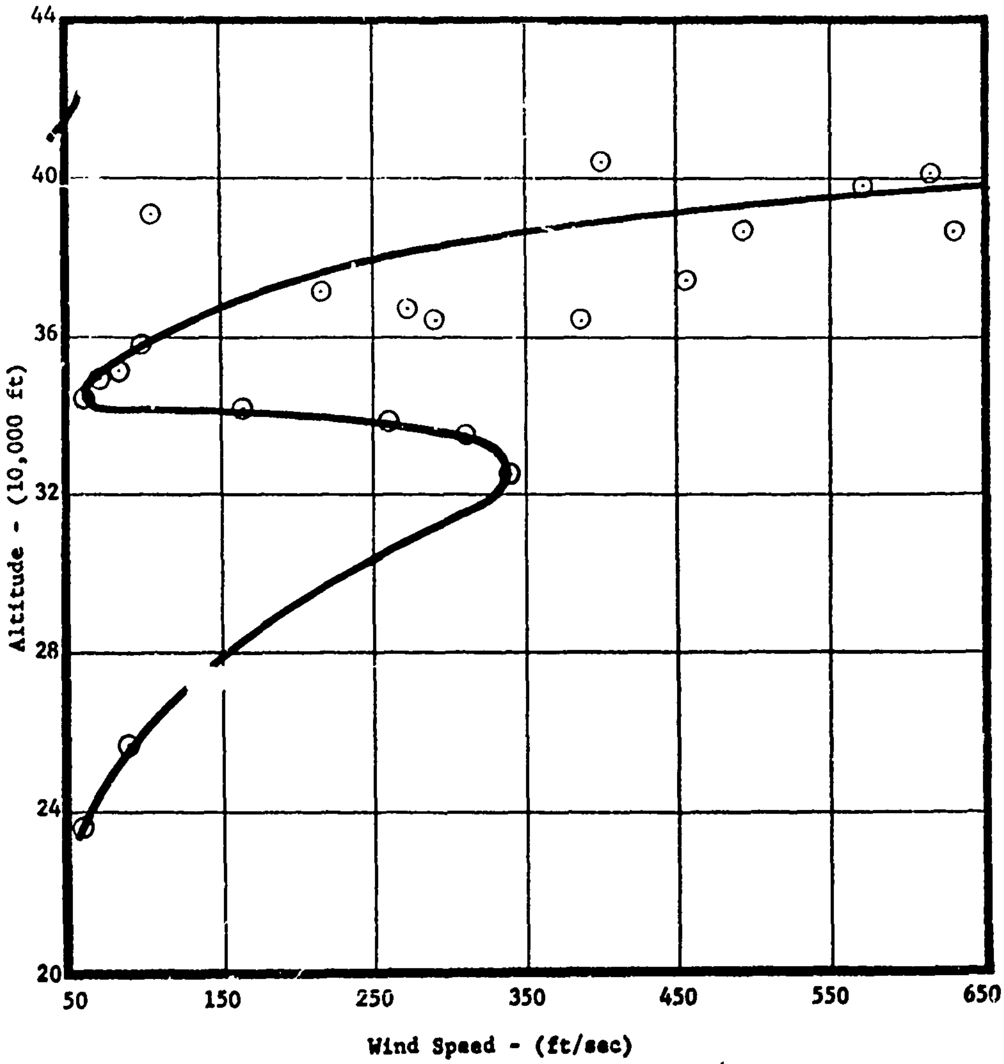



Figure 8. Wind Speed Profile for Upper Atmosphere Extremes

Between 250,000 and 400,000 feet, cylinders (6) of ionization are formed by small particles entering the ionosphere after bombardment of the earth's outer atmosphere by meteors. These cylinders vary in length up to fifty miles but are only a few hundred yards in diameter. The presence of high velocity winds at 300,000 feet can be detected from the distortions of these trails by using radar to make records of the distortions (16). There is a possibility, however, that the electrical conditions in the atmosphere provide this distortion rather than the winds.

Radio determinations have been made of the movement of sporadic E clouds in the ionosphere (17). Assuming that the wind moves these clouds, a measurement of wind direction and velocity can be made. However, this movement may be only an electron drift and not a wind effect.

Drift of noctilucent clouds has been studied in Norway to determine high level wind speed and direction. Those clouds occur rarely however, and the measurements depend upon optical triangulation which gives questionable accuracy to the wind values (6).

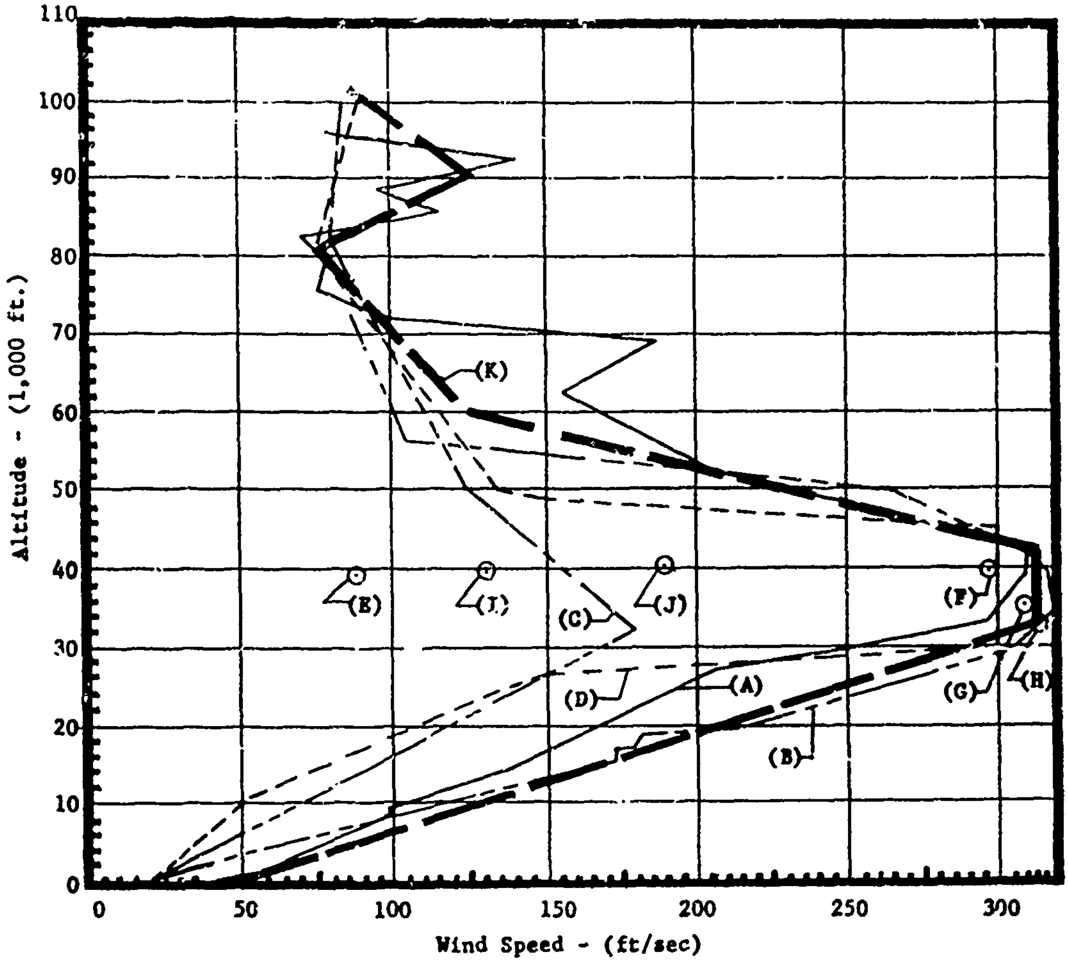
Wind speed profiles generally show a regular pattern as indicated previously. Although the basic curvatures of the speed plots are similar, the magnitudes of the speed curves with respect to altitude for a particular location vary considerably with the seasons. Most areas show a maximum wind speed in winter and a minimum in summer, with the exceptions of the eastern United States which has its maximums in the spring and the Central Pacific which sees very little change in wind speed as a function of the seasons.

Tropical wind data, that is wind circulation data from the area about the equator, are somewhat scarce; however, there have been some reasonably complete recordings taken in the Central Pacific for the period from April to June 1958 as part of Operation Hardtack (18). The tropical stratospheric circulation has been found to consist of two primary currents, the Krakatoa Easterlies ($E_K$) and the Benson Westerlies ($W_B$). Soundings have shown the $E_K$, starting at 60,000 to 80,000 feet and extending upward as high as balloon soundings, have reached 154,000 feet. The core of the $W_B$ is generally confined to the region between 60,000 and 80,000 feet and within 10 degrees of the equator. At the beginning of the study period the $W_B$ were centered near the equator between 60,000 and 80,000 feet and extended north at least 12 degrees. The approximate maximum velocity in the center of the current was about 37 fps and remained very nearly the same for the duration of the study period. The direction of the wind remained from the west with a stream thickness of 15,000 to 20,000 feet above and below the core, changing to an east wind beyond these limits. The east winds above the $W_B$ increase with altitude, eventually becoming the $E_K$ which maintained a velocity from 195 to 260 fps in and about the core. The core fluctuates around an altitude of 150,000 feet and maintains its position between 5 and 15 degrees of North latitude. An analysis of a number of observations made for each month of the year from January 1950 to August 1958, in order to check the reliability of the presented data, showed there was very little monthly variation

and no apparent correlation between variations in number of observations and variations in the zonal components. Several other isolated soundings at the same general latitudes at other locations of the globe have shown the existence of the same or similar winds to $E_K$ and $W_B$. This leads to the conclusion that they may in fact encompass the earth at their appropriate latitudes.

The strongest winds aloft are found over Japan and the northeastern North American seaboard. The lowest tropospheric wind speeds are found over Alaska and the Aleutians, although recent discoveries have shown the existence of a "polar-night" jet stream existing at very high altitudes over portions of Alaska and most of Northern Canada (19). Because of the great altitude of the core of the polar-night jet stream, only isolated observations have penetrated the core, and this scarcity of data renders the construction of synoptic cross-sections difficult. For a more definitive determination of the structure of this current, all soundings of the North American Arctic were combined into one cross-section for a four-day period from December 31, 1957 to January 3, 1958, when the jet stream was in relative steady state. It turned out that the core was located at a height of 85,000 feet and had an average speed of 230 fps with extremes as high as 300 fps. Below this altitude the atmosphere was essentially isothermal; above it temperatures increased upward. Although its existence may have importance in certain Arctic mission requirements, its effect is inferior in force to the jet streams common in the middle latitudes.

As stated previously the predominant wind current in the middle latitudes is the "jet stream" at the 35,000 foot altitude. It is the most important of all wind currents in regard to the majority of vehicle control problems, since it is in the region where it produces the highest q values compared to other jet streams. From the general data presented and specific data from soundings at various stations located to provide the broadest representative cross-section of the Northern Hemisphere, a series of wind speed vs altitude curves is presented with their respective probability of occurrence factors. A 1% probability of occurrence series of curves for wind speed vs altitude is shown in Figure 9. Curve "A" is a plot of the wind conditions at Cape Canaveral, Florida, Curve "B" is a plot of wind conditions at Tateno, Japan (usually considered the general area of maximum speed for the 35,000 foot jet stream), and Curve "C" is a plot of wind conditions at Wray, Colorado. From Figure 9 and Figure 5 it may be seen the wind speed follows the same basic contour with respect to altitude, irrespective of season and location. If given a point of 1% probability at the maximum-speed altitude, one could "fair in" a reasonably accurate curve above and below the maximum speed point. Points E through J are points of maximum 1% probability wind speed at their respective locations and altitudes, and are included to show that the Cape Canaveral wind speed characteristics are fairly representative of the maximum 1% probability winds that might be encountered over the United States. Curve D is a curve from Sissenwine (1), which he states may be used as a representative profile for 1% probability wind conditions in the areas of the United States with strongest wind conditions in the 30,000 to 45,000 foot altitude range. Curve D is also shown with its usage instructions in Figure 10; and even though its peak wind speed




Locations:

(A) Cape Canaveral, Florida (20)
(B) Tateno, Japan (22)
(C) Wray, Colorado (6)
(D) General for United States (1)
(E) Santa Maria, California (22)
(F) Patrick A.F.B., Florida (21)
(G) Bedford, Massachusetts (21)
(H) Washington, D. C. (21)
(I) Boston, Massachusetts (22)
(J) White Sands, New Mexico (1)
(K) Generalized Global Profile

Figure 9. Wind Speed Profile for 1% Probability

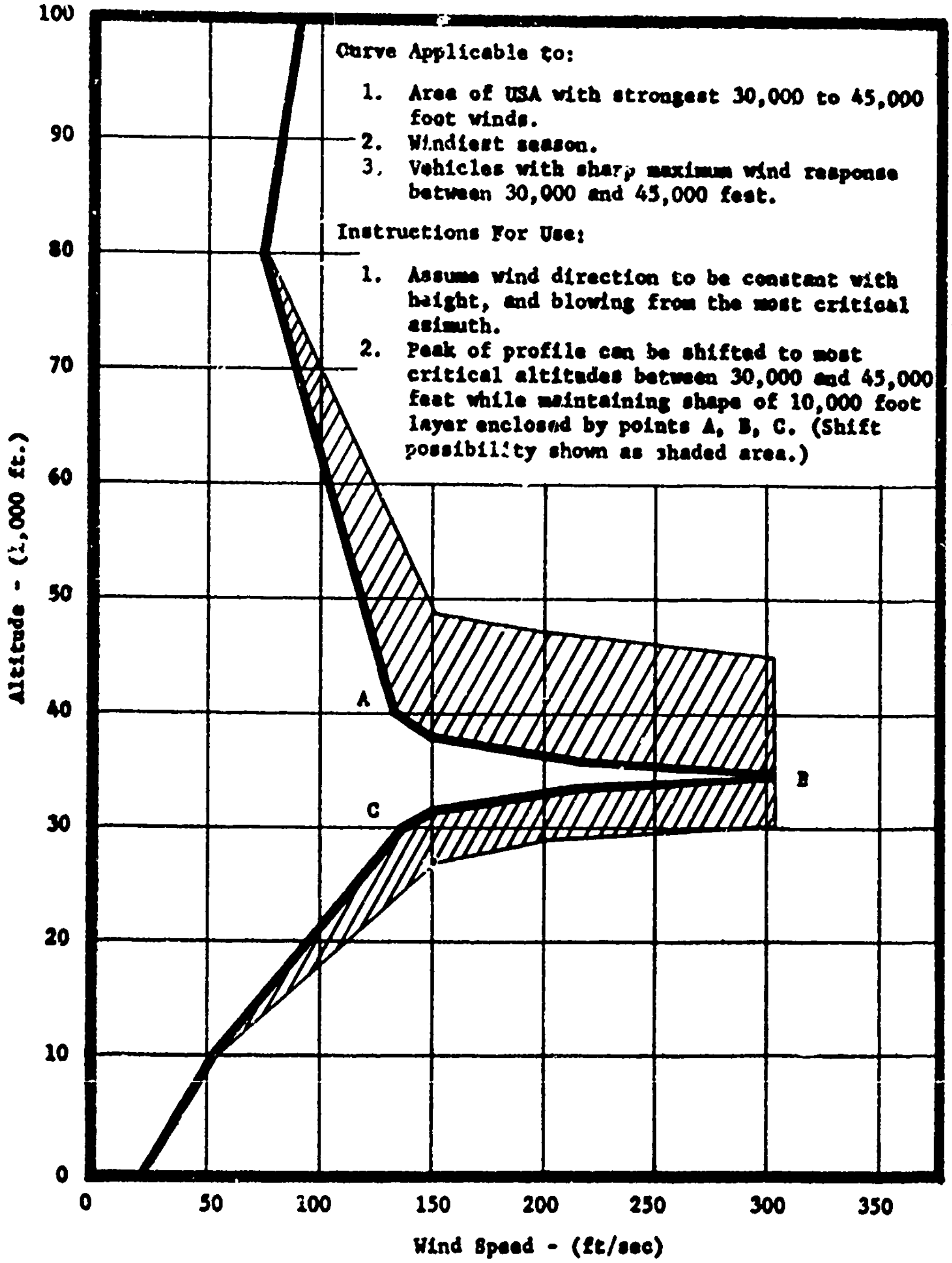



Figure 10. Synthetic Wind Speed Profile for 1% Probability

of 300 fps falls a little short of some of the peak 1% probability winds encountered in the Eastern United States, it is a very good guide and probably could be used with considerable reliability as a guide to wind conditions in the United States. The peak 1% probability wind speeds for the United States have been recorded as 310, 314, and 321 fps at Cape Canaveral (20), Washington, D. C. and Bedford, Mass. (21), respectively. Also included as part of Figure 9 is a K curve, which has been drawn as a speculation to meet global conditions of 1% probability of wind occurrence. This curve is felt to be broad enough in its coverage to be representative of the maximum 1% probability wind conditions that might be encountered by any vehicle designed to operate in the Northern Hemisphere.

Generally 1% probability is severe enough to meet most vehicle applications; but for specific applications, where more severe wind characteristics are required to be accounted for, a curve of 0.1% probability (23) has been presented in Figure 11. The curve represents the average 0.1% wind conditions of several stations located in different areas of the jet stream, and can be used with a reasonable amount of confidence as representative of the severest conditions that might be encountered at any location in the Northern Hemisphere. For application where a vehicle is to be used only during favorable conditions, during specific seasons, or only at specific times and locations, then 1% and 0.1% wind probability of occurrences may be too severe and costly to be used as design conditions. For these cases Figures 12 and 13 have been included. The figures show curves of 5%, 10% and 20% probability of occurrence wind conditions, respectively, at representative locations.

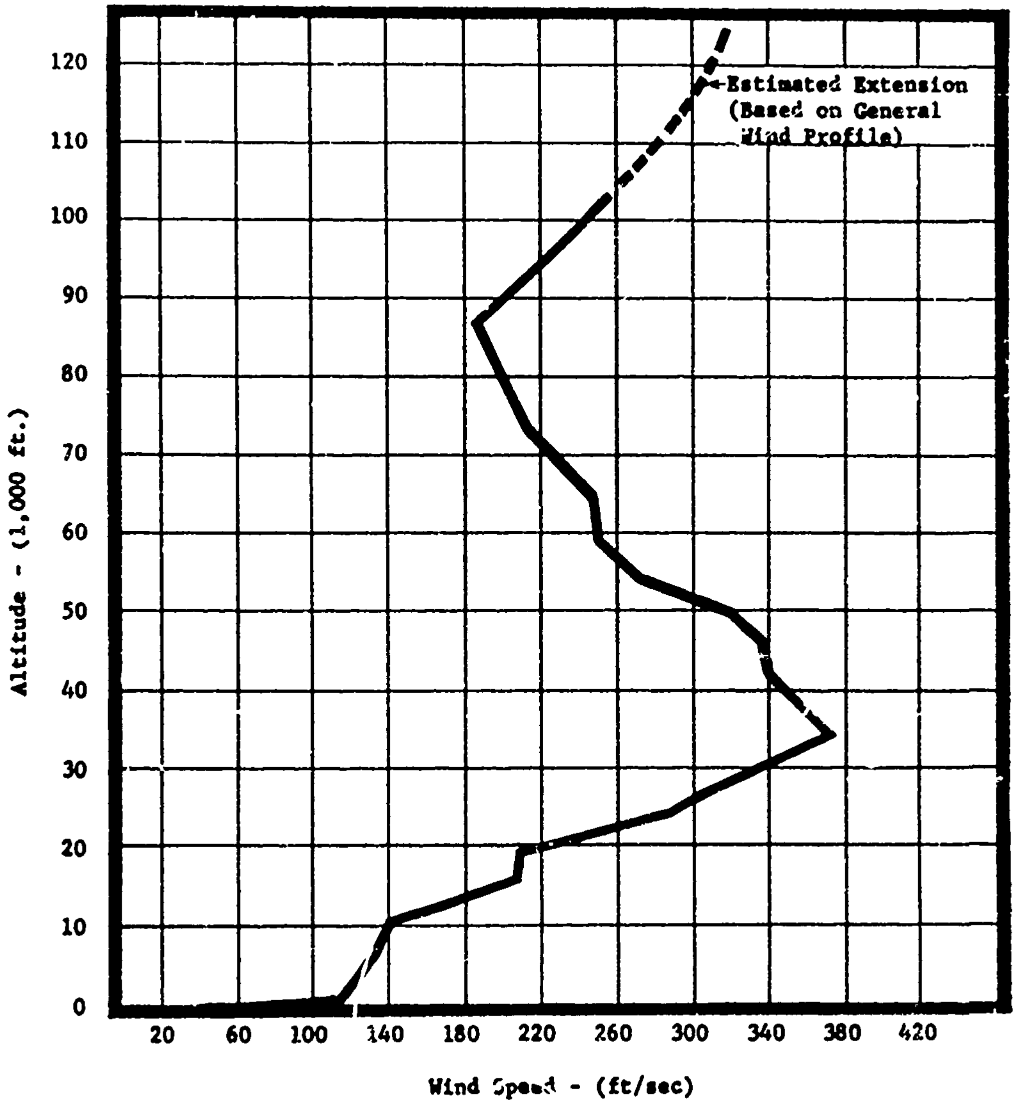
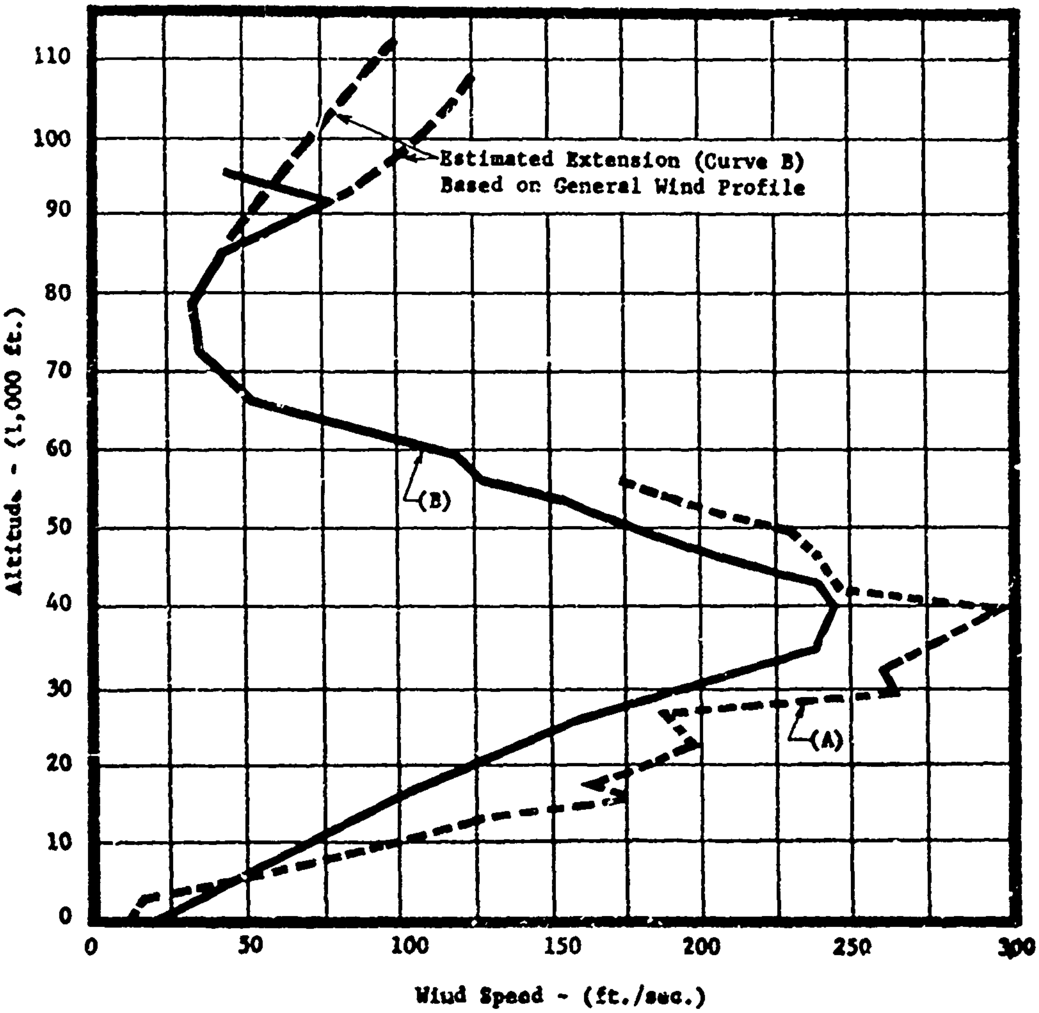
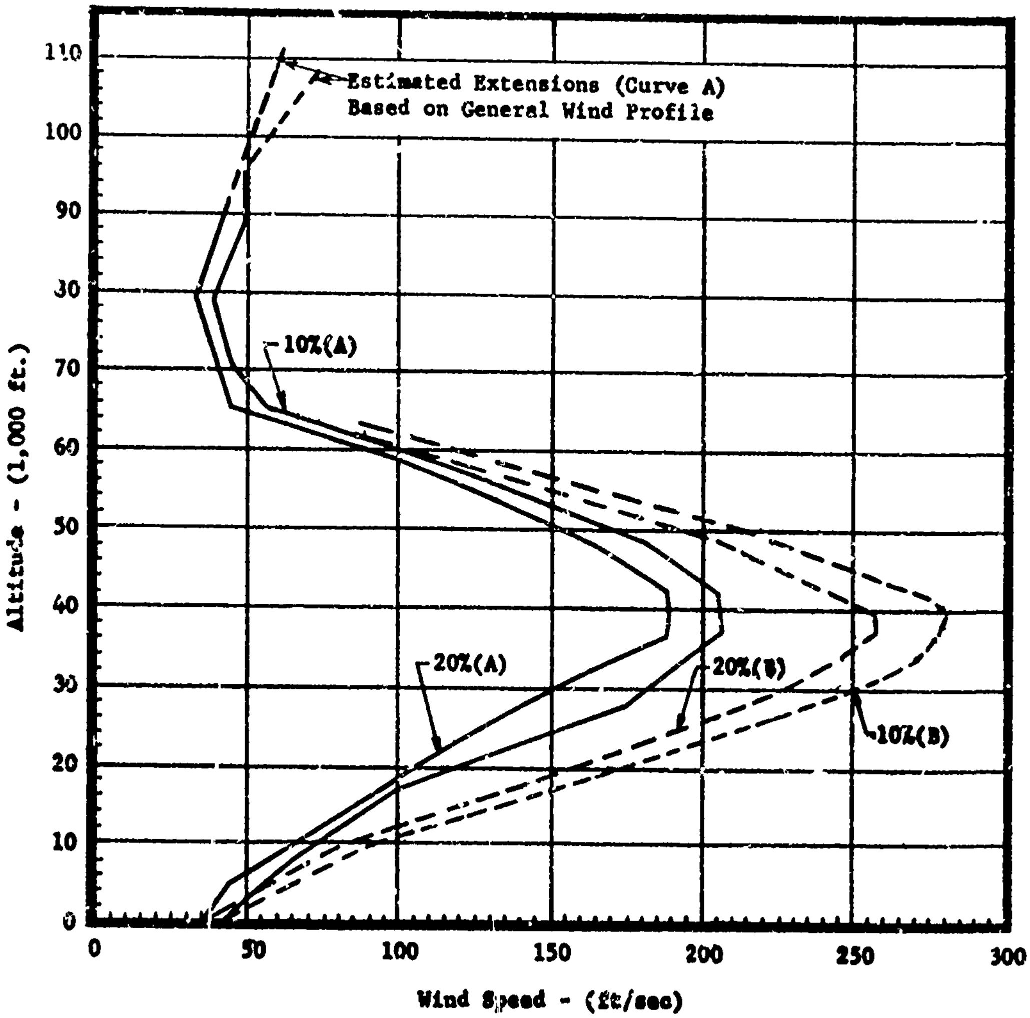



Figure 11.. Wind Speed Profile for 0.1% Probability




(A) Curve - Data from the Cape Canaveral Area (20).
(B) Curve - Data from the Tateno, Japan Area (22).

Figure 12. Wind Speed Profile for 5% Probability




(A) Curves - Data from Cape Canaveral Area (20).
(B) Curves - Data from Tateno, Japan Area (22).

Figure 13. Wind Speed Profile for 10% and 20% Probability.

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WIND SHEAR

The information presented in the previous subsection on wind velocities and probability of occurrence with respect to altitude is of interest in the analysis of control systems for many aircraft and missiles. For missiles and aircraft capable of high relative rates of climb or descent there is also a need for detailed information on wind shears. Large shears are generally observed in conjunction with strong horizontal winds. Fortunately, there is little change in wind direction with height in the levels near the strongest winds (1); shear can therefore be treated as a result of the difference in magnitude of the wind speed. A discussion of the directional variability which does occur is contained later in this subsection.

As used in this report vertical wind shear is the average wind gradient in the vertical, the difference in the wind velocities at the upper and a lower altitude divided by the altitude increment $\Delta h$. The length $\Delta h$ is termed the shear gradient distance. Wind shears for gradient distances of less than 5,000 feet are generally considered localized, and fluctuate more rapidly with time than the general wind gradient of the preceding subsection. Because wind shear does fluctuate rapidly with time, it is generally superimposed on the general wind gradient. Vertical wind shear (2) is formed from two components: longitudinal wind shear, in which the component of wind velocity at the upper altitude is parallel to the wind direction at the lower altitude, and normal wind shear in which the component of wind velocity at the upper altitude is normal to the wind direction at the lower altitude. For the purpose of this report a shear layer will be defined as an altitude interval for which the calculated longitudinal or normal wind shear is equal to or greater than the standard 6 ft/sec/1,000 ft.

Most wind shear data in the less than 100,000 foot altitude range have been gathered in the past with the AN/GMD-1 rawin balloon tracking system, but is presently being gathered with a newer more accurate system called the AN/GMD-2 rawin system. In general, the two systems are very similar. The AN/GMD-1 system measures the elevation angle and azimuth of the balloon by means of a radio direction finder. The balloon's altitude is computed from the temperature, pressure, and humidity data transmitted to the ground receiver by a radiosonde. Wind speeds are then obtained by calculating the horizontal distances transversed in a given time, utilizing the elevation angle and the tangent law to obtain the horizontal distance to the balloon and the horizontal angle to determine azimuth. The use of the law of tangents is considered responsible for the major inaccuracies in AN/GMD-1 observed winds, since wind calculations are based on the formula that horizontal distance is equal to the altitude multiplied by the cotangent of the elevation angle. At low elevation angles, which correspond to maximum range and altitude, the cotangent value changes very rapidly for very small changes in angle; therefore, any small elevation angle errors, due primarily to hunting of the AN/GMD-1 antenna, will result in erroneous wind calculation.

The AN/GMD-2 rawin system utilizes the standard AN/GMD-1 ground equipment and a newly developed phase-shift ratio ranging attachment. This ranging attachment provides direct measurement of the slant range between the ground equipment and the balloon, along with the standard recording of azimuth and elevation angles. By use of cosine and sine functions both height and horizontal distance can be computed directly, employing the slant range in conjunction with the elevation angle. This considerably reduces any errors in wind speeds due to incorrect elevation angles since the wind speed may be closely approximated by the difference in slant range between any two observations divided by the time interval.

In order to illustrate the method of evaluating data gathered by Tolefson (2) using the AN/GMD-1 rawin system and Dvoskin (3) using the AN/GMD-2 system for measuring vertical wind shear, a general set of equations and their usage will be presented. For the determination, the wind vector at the surface is taken as a reference and the wind vector at the next highest altitude is then resolved into components along and normal to the direction of the surface wind. The average wind shear for each component of this layer is then given by the difference between each component and the surface wind speed divided by the altitude interval between the two levels. For the longitudinal component of the first altitude interval, the shear S is given by (See Figure 14):

$$S = \frac{V_1 \cos (\alpha_1 - \alpha_o) - V_o}{h_1 - h_o} \qquad (1)$$

where $h_1 - h_o$ is the height of the layer selected for evaluation.

In evaluating the data, it is of course necessary to set some lower limit or threshold which is based on both the accuracy of the data and the value which may be significant. For such considerations the threshold of 6 ft/sec/1,000 feet was established for the evaluation. If the value of S determined by equation (1) is less than the threshold of 6 ft/sec/1,000 feet, the wind shear is discarded. The wind vector $V_1$ in Figure 1 is then taken as the new reference, and the calculation for the component of wind shear in the direction of $V_1$ and between altitudes $h_1$ and $h_2$ is similarly made. If the new value is also less than the threshold, it is discarded and $V_2$ is taken as the reference. If, however, the value of S as determined by equation (1) is 6 ft/sec/1,000 feet or greater, the extent of the shear layer is determined by calculating the longitudinal component of the wind shear for the next altitude interval. By referring to Figure 14, this calculation for the shear increment $\Delta S$ can be made from the relation:

$$\Delta S = \frac{V_2 \cos (\alpha_2 - \alpha_o) - V_1 \cos (\alpha_1 - \alpha_o)}{h_2 - h_1} \qquad (2)$$

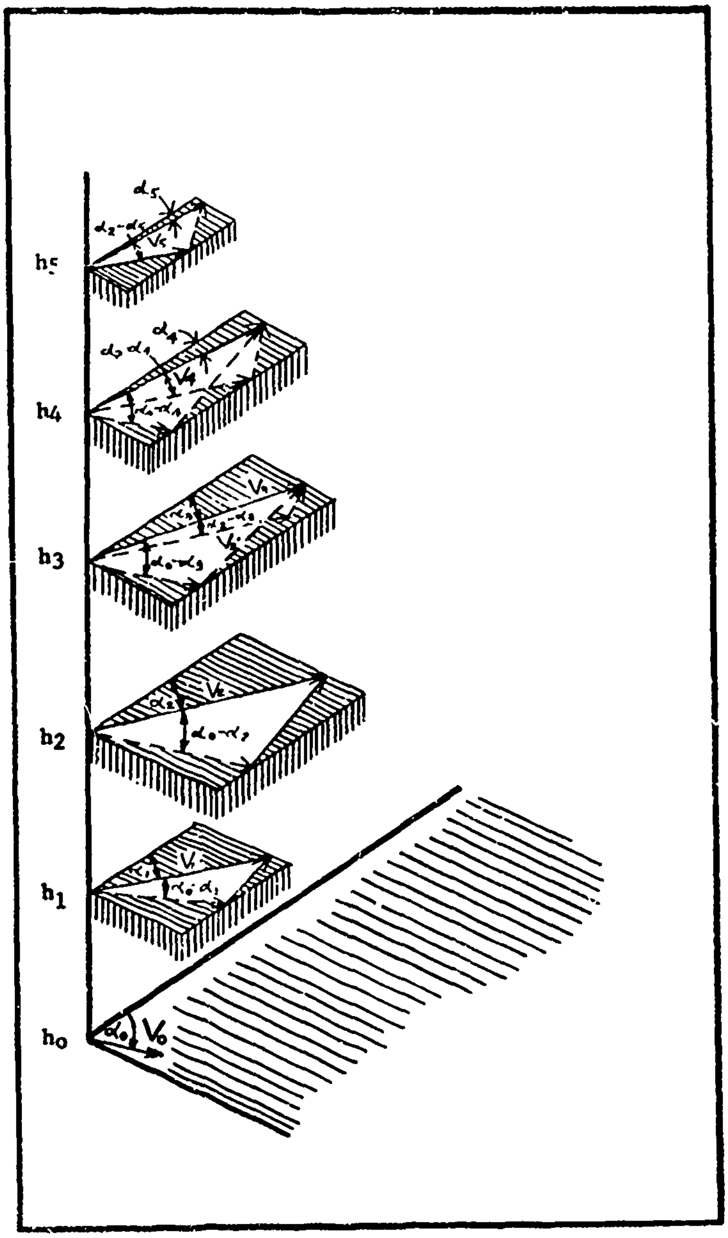


Figure 14. Vector Illustration

For the case where $\Delta S$ is less than 6 ft/sec/1,000 feet, the original value of S is the desired wind shear, and the thickness of the shear layer is $h_1-h_o$. For the cases where $\Delta S$ is equal to or greater than 6 ft/sec/1,000 feet, the calculation indicated by equation (2) is repeated for vectors $(V_3, V_4)..(V_{n-1}, V_n)$ until a value less than the threshold is obtained. This point then indicates the top of the shear layer. The final value for the longitudinal component of the shear for the layer is given by:

$$S' = \frac{V_n \cos(\alpha_n - \alpha_o) - V_o}{h_n - h_o} \tag{3}$$

In proceeding with the calculations, the upper altitude $h_n$ now becomes the reference for the next shear layer. In these calculations a wind shear layer includes only those values of $\Delta S$ which are in the same direction as the shear for the initial interval; that is, $\Delta S$ must have the same sign as S. Also the shear values represent only the average velocity gradient over a given altitude interval. The method of computing the winds from the recorded surface data, in addition, tends to smooth the sharper velocity fluctuations which may occur between the approximate 1,000-foot observing intervals.

The steps for calculating the normal component of wind shear are similar to those given for the longitudinal component except that the cosine function is replaced by the sine function; and, of course, $V_o$ drops out of equation (1) and (3). The value for the normal component of the shear for a given layer is represented by:

$$S' = \frac{V_n \sin(\alpha_n - \alpha_o)}{h_n - h_o} \tag{4}$$

Soundings are evaluated for the longitudinal and normal components of the wind shear and the depth of the shear layers by means of the procedures discussed in the preceding paragraphs. When evaluated in this way they show considerable variation in the intensities and altitudes of the shear layers from one sounding to another. The method of analysis presented gives the general characteristics of the shear layers as obtained from an analysis of balloon soundings. As has been indicated, these results provide measurements of only the average shear gradients for layer thicknesses greater than about 1,000 feet, and are limited in accuracy, particularly at the higher altitudes. The data, however, provide information on, at least, the general level of the shear intensities and their frequencies of occurrence; and afford a basis for assessing the significance of the shears.

## Shear Intensities and Frequencies

According to Tolefson (2) very intense longitudinal shears of 100 ft/sec/1,000 feet or greater are of occasional occurrence in the winter and spring months, and values of about 80 ft/sec/1,000 feet occur occasionally in the summer and fall months. Normal shear intensities are smaller but still remain about 50 to 60 ft/sec/1,000 feet. These values indicate that intense vertical wind shears may be encountered, particularly at altitudes from 30,000 to 80,000 feet. Another investigation conducted by Tolefson in the Washington, D. C. area presents statistical arrays of shears, measured with the AN/GMD-1 rawin system, at different seasons, for 16,000 foot altitude increments up to 100,000 feet. Tolefson recorded a number of shears greater than 0.1 per second, which is more than twice as strong as Sissenwine's (1) 1 percent design* shear in a similar area. Sissenwine and Tolefson recognized the deficiency in AN/GMD-1 shear data and agreed that values of shears measured with this equipment were only rough approximations of the true shears. Sissenwine attempted to remove the instrumental error by using the average shear near the level of peak winds for 50 typical high-speed wind profiles prepared by R. Endlich of GRD, AFCRC, in his study of the jet stream. Tolefson's report indicates in great detail the errors possible from instrumentation, but he does not correct for these in shears presented. Consequently, Sissenwine's report tends to reduce extreme shears of low probability and Tolefson's tends to magnify these values.

More recent data as presented by Dvoskin (3) and other (4) writers give values of the maximum longitudinal wind shear to be expected over the eastern seaboard of the United States as about 77 ft/sec/1,000 feet. The AN/GMD-1 system used by Tolefson as explained previously can no doubt be credited with most of these differences, since the AN/GMD-1 system is subject to a hunting limitation. This limitation is such that an error in wind speed at a given altitude has a root-mean-square value during strong wind speeds which may approach the difference in speed (the shear) between two adjacent layers. For example, Kochanski (4) quotes Spohn as indicating instrumental uncertainties of 14 ft/sec (root-mean-square error) at a wind speed of approximately 120 ft/sec. A typical shear with such a wind speed is about 0.015 per second, as will be seen from an expression by Dvoskin (3) presented below. If such a shear were encountered over a 1,000-foot thick layer, it would result in a wind speed difference across this layer of 15 ft/sec. However, Spohn indicates that the error in measuring the speed at the bottom and top of this layer will be greater than 14 ft/sec 32 percent of the time so that little confidence can be given a shear measurement of this magnitude with this equipment. Unfortunately, the pressing design problems presented by the accelerated space and defense programs have necessitated the use of much of this data.

The Geophysics Research Directorate of the Air Force Cambridge Research Center is currently accumulating data with the new AN/GMD-2 rawin system. With the introduction of the AN/GMD-2 system, it is hoped that the accuracy and efficiency of measuring high level wind conditions will be greatly

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* See definition of probability of occurrence on page 8.

improved, so that shear design criteria may be based on well founded data. One phase of the early field testing was a series of forty-five soundings (3) in the Bedford, Massachusetts area that were obtained during the winter and spring of 1957. Maximum wind speeds in the 30,000 to 40,000 foot altitude zone varied from about 42 to 305 ft/sec. Shears have been calculated for 1,000, 3,000, and 5,000-foot altitude thickness for balloon movement averaged for two minute intervals, according to the standard procedure, and also for one minute intervals. For the investigation, it was decided to examine the relationship between wind speed and maximum wind shear in the 30,000 to 40,000 foot altitude interval, using 3,000-foot shear thickness and two minute average balloon movement. Greatest shears for thin layers are generally found above the nose of the wind profile. This is evidenced in the forty-five AN/GMD-2 soundings and elsewhere (4). The maximum longitudinal 3,000 foot shear found was 0.051 per second and was associated with the 305 ft/sec wind profile. The maximum 1,000-foot thick shear within this 0.051 per second, 3,000-foot shear was 0.077 per second.

Dvoskin (3) found a correlation coefficient of 0.63 for the relationship of maximum 3,000-foot shear to maximum wind speed in the 30,000 to 40,000 foot level. The curve of the linear regression found is $Y = 0.00299 + 0.000142X$, where Y is the shear in $sec^{-1}$, and X is the speed of the wind in knots. The standard error of estimate of the shear is 0.0063 per second.

Probability of occurrence of winds and shears in the 30,000 to 40,000 foot layer for forty-five AN/GMD-2 soundings at Bedford, Massachusetts during the winter and spring of 1957 are presented in Table 1. These figures are given for four probabilities of interest as obtained from accumulative frequencies plotted on normal probability paper. It had been hoped that the expression relating shear to wind speed could be used to correlate the associated values of shear for the wind speed given in Table 1. However, the shears obtained in this manner have lower magnitudes and consequently higher probability than the actual values measured for strong (low expectancy) winds. Substituting the 1 percent wind speed, 190 knots in the shear and wind speed regression expression provided above, yields a shear of 0.030 per second. However, the 1 percent shear in Table 1 is 0.050 per second.

There appears to be no "clear" correlation between extreme shears and strong wind profiles. Sissenwine (5) suggests, however, that the design profile should include a shear of approximately the same probability as that of the wind. Based on this conjecture he estimated shears of the same probability as Table 1 for Patrick AFB by a proportionality with the ratio of the wind speeds at the related locations. In applying the shear data presented in Table 1 to the wind speed for Patrick AFB, one can legitimately question whether or not the relationship for winds in the Massachusetts area holds over Patrick. As previously stated in the wind speed section and (6), investigations of wind structure in jet streams have indicated that horizontal shear near the nose of the jet does not vary significantly with location. Other studies (7) indicate a similar conclusion

may be valid for the vertical shear. Sissenwine's predicted wind shears at Patrick AFB have been substantiated by later measurements (8); therefore, his prediction method may be useful for approximating wind shear at jet stream altitudes for other locations where a wind profile is available.

TABLE 1

| PROBABILITY OF OCCURRENCE | WIND SPEED | | 3,000 FOOT LONGITUDINAL SHEAR | |
|---|---|---|---|---|
| (%) | (Knots) | (ft/sec) | (ft/sec/1000 ft) | ($sec^{-1}$) |
| 1 | 190 | 321 | 50 | 0.050 |
| 5 | 153 | 259 | 29 | .029 |
| 10 | 134 | 226 | 23 | .023 |
| 20 | 110 | 186 | 18 | 0.018 |

When considering wind shear criteria, shears through layers thinner than 3,000 feet directly above and beneath the wind speed maximum should be examined. Shears for layers as thin as 1,000 feet, for example, will approach 1.5 times the 3,000 feet maximums. The shear layer thickness and the probability of occurrence versus shear intensity are shown in Figure 15 for shears associated with maximum (30,000 to 40,000 foot) wind. These curves of the Bedford area wind conditions can be considered, with only slight reservation, as representative of the maximum wind shear conditions that might occur in the United States. The slight reservation is due to the relatively few number of observations on which the results of the Bedford study are based. From a Navy study (9) it appears that the Bedford, Massachusetts location has only a slightly lower wind speed regime than the distribution for Washington, D. C., which is assumed to be located in the windiest (upper air) geographic area of the United States. The mean winter wind speed at Nantucket, only 95 miles southeast of Bedford is 82 knots at 40,000 feet, compared to a value of 83 knots at 40,000 feet above Washington.

The shear information from the United States can be projected, with a reasonably high degree of confidence, as representative of the maximum shear conditions that might be expected in the Northern Hemisphere. Although other areas of the hemisphere such as Japan have stronger wind velocity conditions, reports such as Reference 10 show the wind conditions to be more stable and gradual in their intensity buildup than similar winds in the United States. Data extracted from Reference 10 permit a comparison

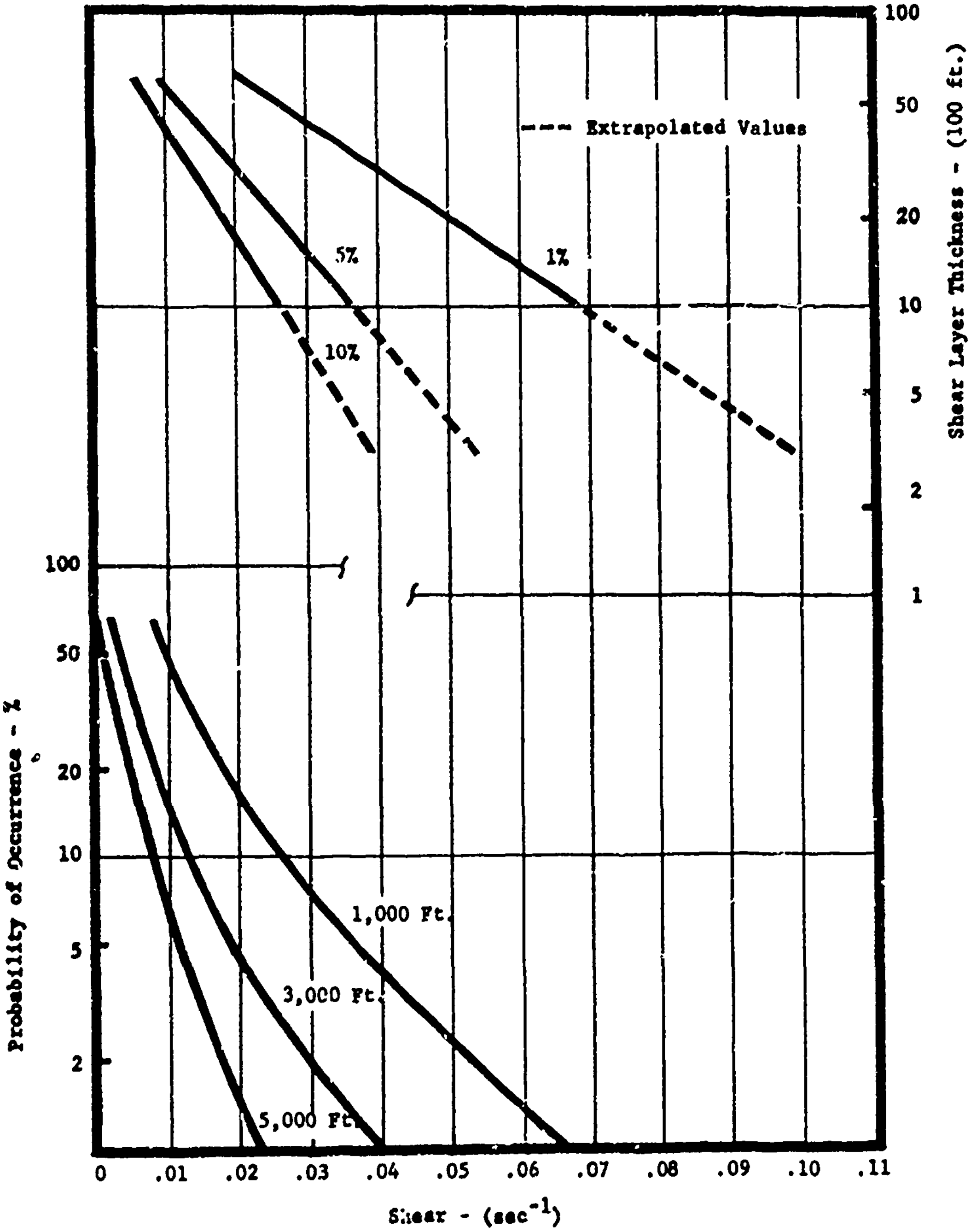


Figure 15. Probability of Occurrence and Layer Thickness for Longitudinal Shears at Level of Strongest Winds.

of wind shears at different altitudes for two locations in the United States and Tateno, Japan as shown in Table 2.

TABLE 2

3,000 FOOT LONGITUDINAL SHEAR LAYERS

| APPROXIMATE ALTITUDE (FEET) | TATENO, JAPAN 1% EXTREME SHEAR ($sec^{-1}$) | SANTA MARIA, CALIF. 1% EXTREME SHEAR ($sec^{-1}$) | BOSTON, MASS. 1% EXTREME SHEAR ($sec^{-1}$) |
|---|---|---|---|
| 10,000 | 0.018 | -- | 0.024 |
| 20,000 | 0.032 | -- | 0.020 |
| 30,000 | 0.041 | -- | 0.032 |
| Jet Stream Level | 0.046 | 0.024 | 0.050 |
| 50,000 | -0.022* | -0.014* | -0.028* |

*(-) denotes negative shear value

Most of the discussion in this and other reports on shears has been concentrated on shears located at jet stream level. However, data from Reference 3 as plotted in Figure 16, indicate that the highest shear at any particular time may be found at any altitude, and occurs between 30,000 and 40,000 feet only in about one-third of the cases. For example, a high frequency (19 percent) of maximum 1,000-foot thickness shears are found between 50,000 and 60,000 feet. The probability of occurrence of shears for all levels is presented in Figures 17, 18, and 19. The 1, 5, 10, and 20 percent extremes for 1,000, 3,000 and 5,000-foot thickness shears are shown. It should be kept in mind that a strong shear at one level does not necessarily imply a strong shear at another level simultaneously. Any relationship which may exist between shears at various levels has not yet been determined. It is interesting to note from the figures that there is an average of about one shear layer in each 5,000 foot altitude interval from sea level to 50,000 feet.

A second consideration of wind shear is the change in direction of wind with height. Frequency distributions of this phenomena are not readily available. As stated previously, strong winds change direction very slowly with height. Sharp wind shifts are generally encountered only in the lower troposphere in connection with surface frontals, surface temperature inversions, or surface turbulence. An inspection of a number of wind soundings according to Sissenwine (1) indicates that a shift in direction of 90° is often encountered from the surface through 2,000 feet (the standard height intervals in the wind reporting code) when the wind

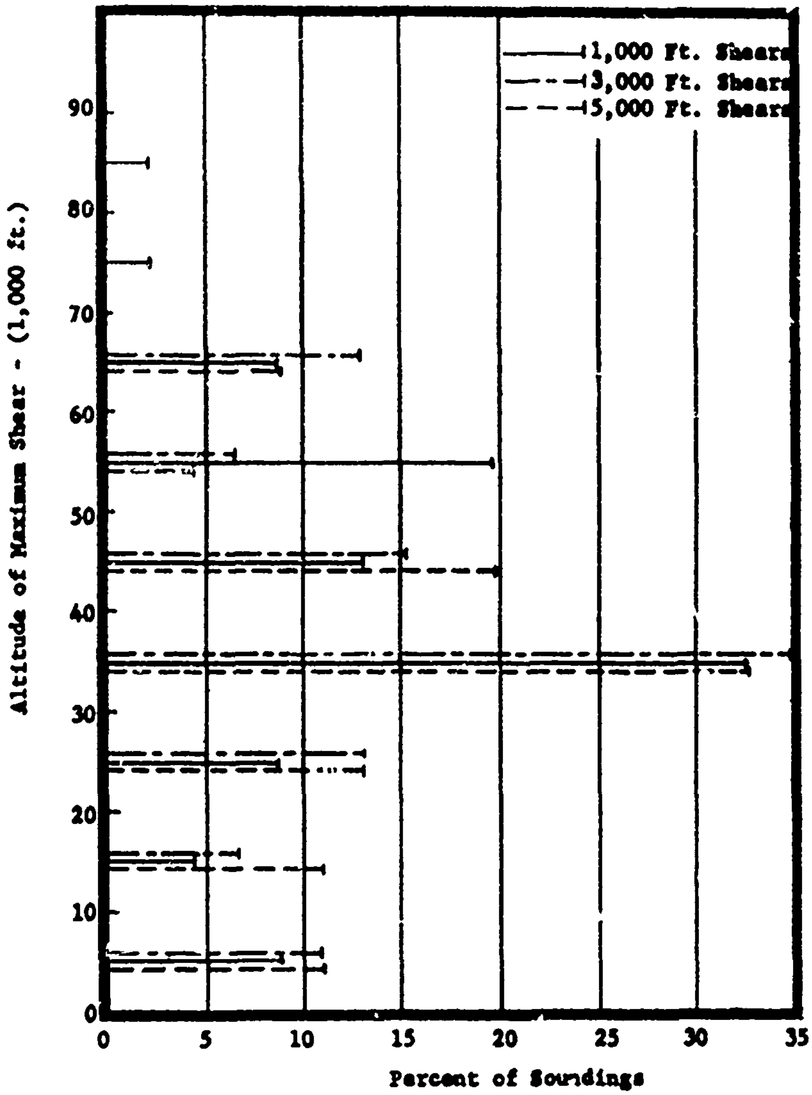


Figure 16. Percent Altitude Occurrence of Maximum 1,000, 3,000, and 5,000-foot Longitudinal Shears.

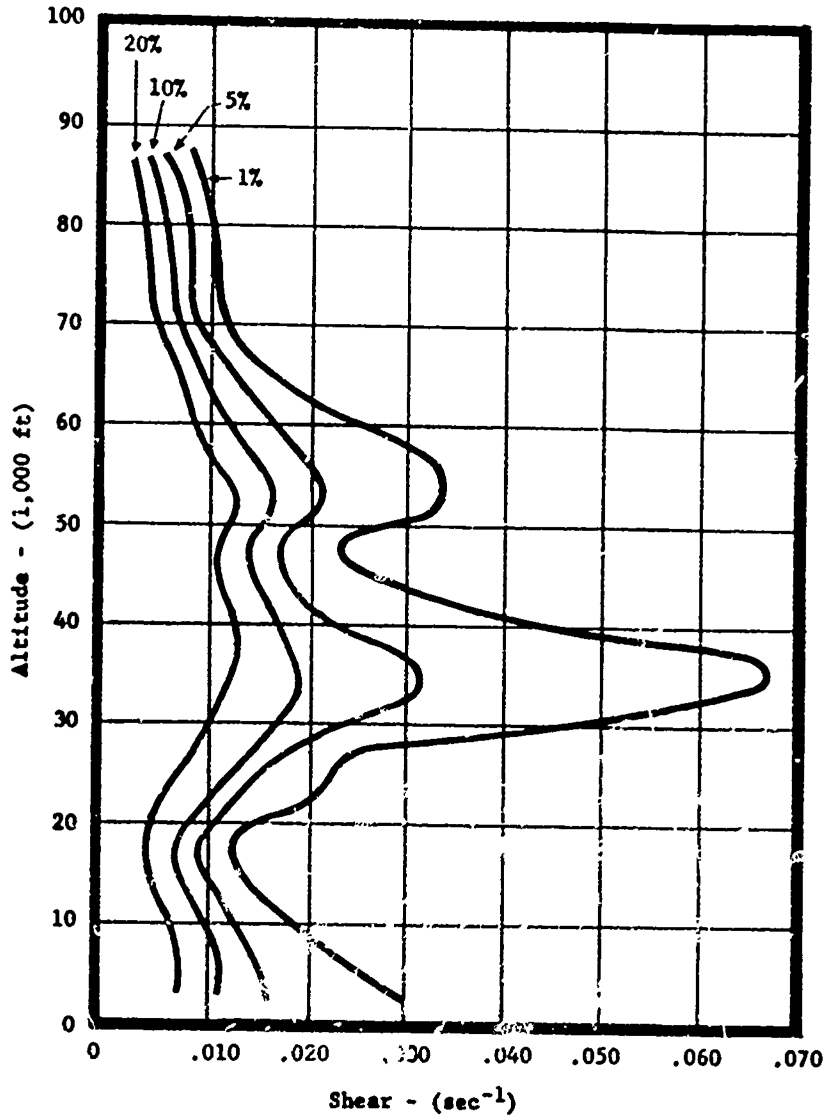


Figure 17. Probability of Occurrence with Height of Extreme 1,000 foot Longitudinal Shear.

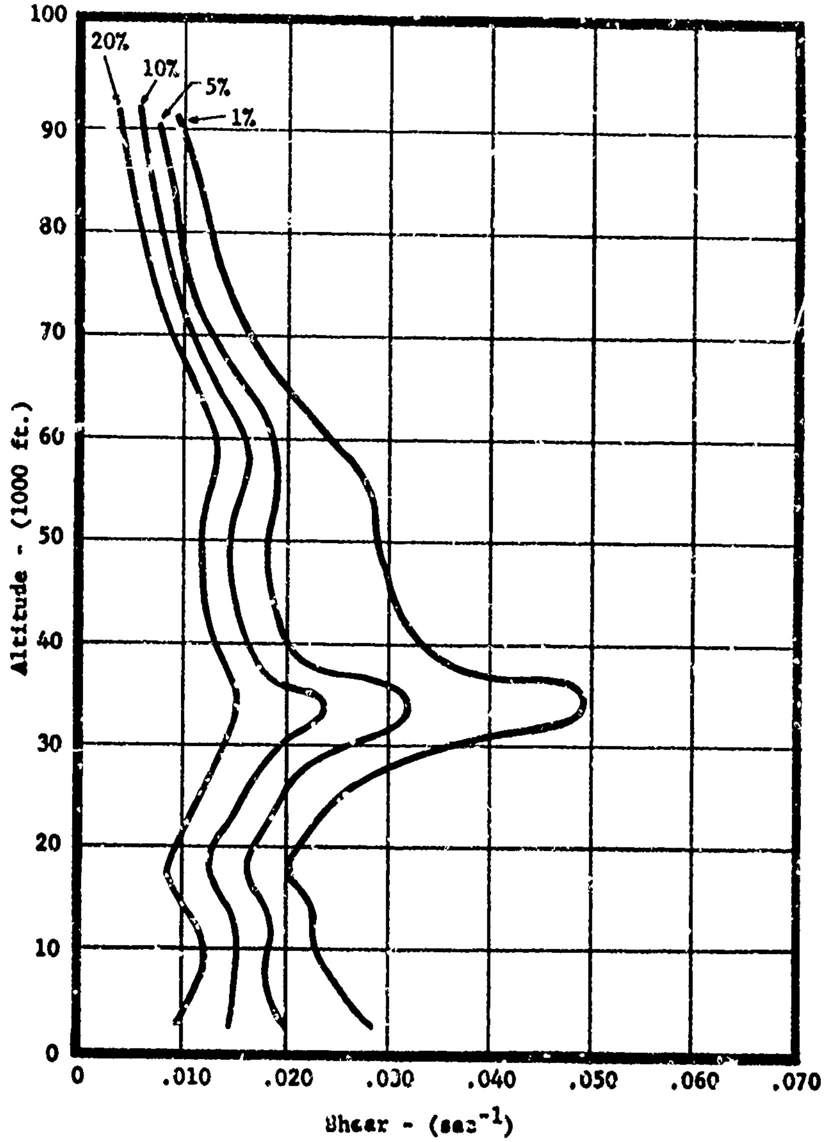


Figure 18. Probability of Occurrence with Height of Extreme 3,000 foot Longitudinal Shear.

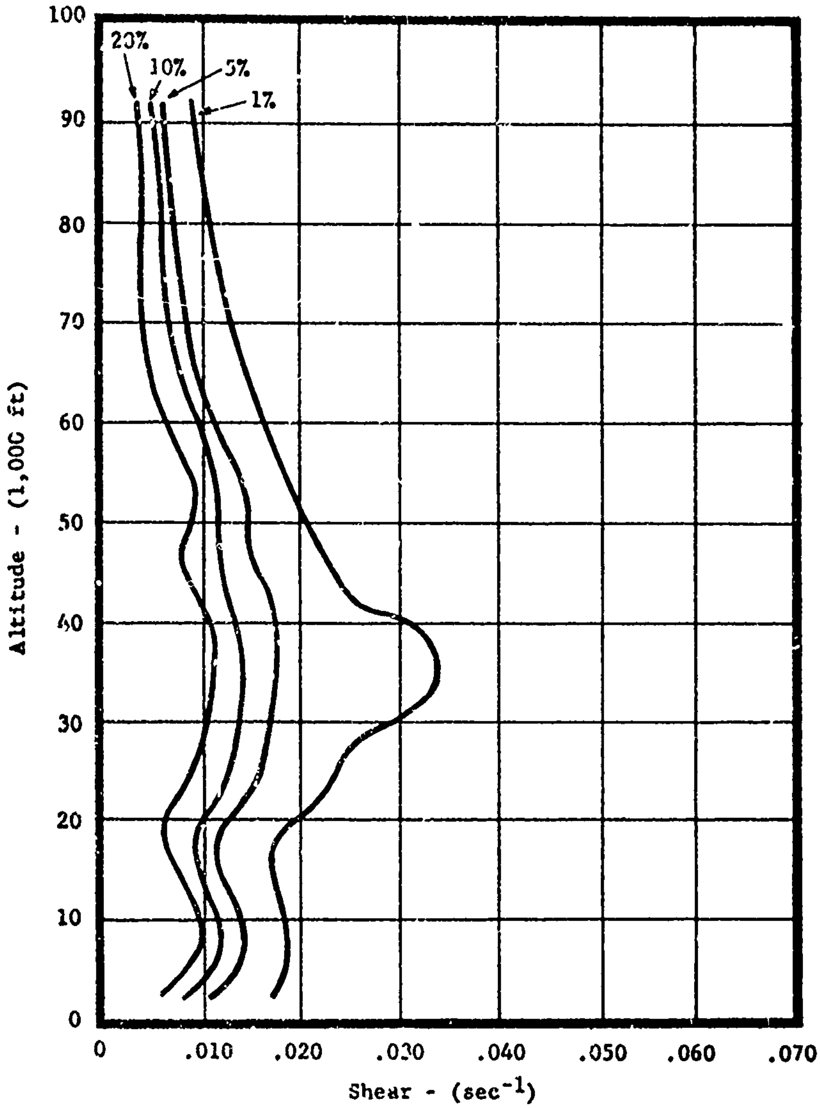


Figure 19. Probability of Occurrence with Height of Extreme 5,000 foot Longitudinal Shear.

speed is very light, i.e., on the order of 15 ft/sec or less. Shifts of 180° in the 1,000 foot frictional level near the ground are also approached at these low speeds. During the equinox periods, when the wind direction shifts quite frequently from east to west in the 50,000 to 80,000 foot altitude interval, a drift approaching 180° in 5,000 feet appears with winds as high as 40 ft/sec; however, because of low air density, the g force will be much less than at the lower level with lesser shear. At the tropopause area from 30,000 to 40,000 feet, the strong winds permit very little change in direction; e.g., 30° in 5,000 feet is occasionally observed when the wind is averaging 50 ft/sec.

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## GUSTS

Wind gusts are the relatively sudden changes in the wind intensity which occur as a result of turbulence or convective activity. The total wind force is the result of several different related conditions, acting individually or collectively. The first of these, as we have seen from a previous subsection, is the mean wind flow which varies slowly; a second is the localized wind shear which is superimposed on the general shear but fluctuates more frequently. Gusts are the relatively rapid wind intensity fluctuations. The basis for presenting the wind speed, wind shear, and gust in individual subsections is to distinguish the three concepts of wind influencing the flight dynamics of vehicles.

### Gust Structure

Gusts at altitudes up to approximately 600 feet are usually measured by fixed anemometers and are discussed in detail in later paragraphs. Gust data at altitudes above 600 feet are obtained from measurements derived from aircraft. For gust measurements obtained from fixed anemometer readings, the time of gust build-up is recorded; whereas on aircraft the distance travelled from the minimum to the peak gust speed is measured. The distance is defined as the gust gradient distance. Horizontal gust data are important in the analysis of controls for vertically rising vehicles, but data obtained from aircraft are generally for vertical gusts only. Fortunately, there is nearly a "one-to-one" relationship between horizontal and vertical gusts, especially for relatively thin (8,000 to 10,000 foot) altitude layers. Data from Donely (1) which shows this relationship are presented in Figure 20. The probability of occurrence*, gust intensity, and gust gradient distance, as obtained from aircraft during horizontal flights and anemometers at fixed locations are covered in this subsection.

Prior to 1954 the formulation used in determining effective gust velocities from vertical accelerations was dependent, to some degree, on the characteristic of the airplane used as the measuring vehicle. A revised gust-load formula was developed in 1954 which, through use of a different gust factor, greatly increased the significance of the data (2). The new gust factor is based on an airplane mass ratio parameter and an assumed gust profile represented by a one-minus-cosine curve whereas the previous alleviation factor was based on airplane wing loading and on a triangular gust gradient profile. The gust velocities obtained in evaluating flight measurements of the airspeed and vertical acceleration of an airplane by use of the revised formula are called the derived gust velocities and correspond to the maximum equivalent velocity for the assumed gust profile. The gust velocities previously obtained from the obsolete method, the so-called effective gust velocities, represented only a fraction of this velocity. The derived gust velocities are accordingly numerically larger for the same

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* See Page 8 for definition.

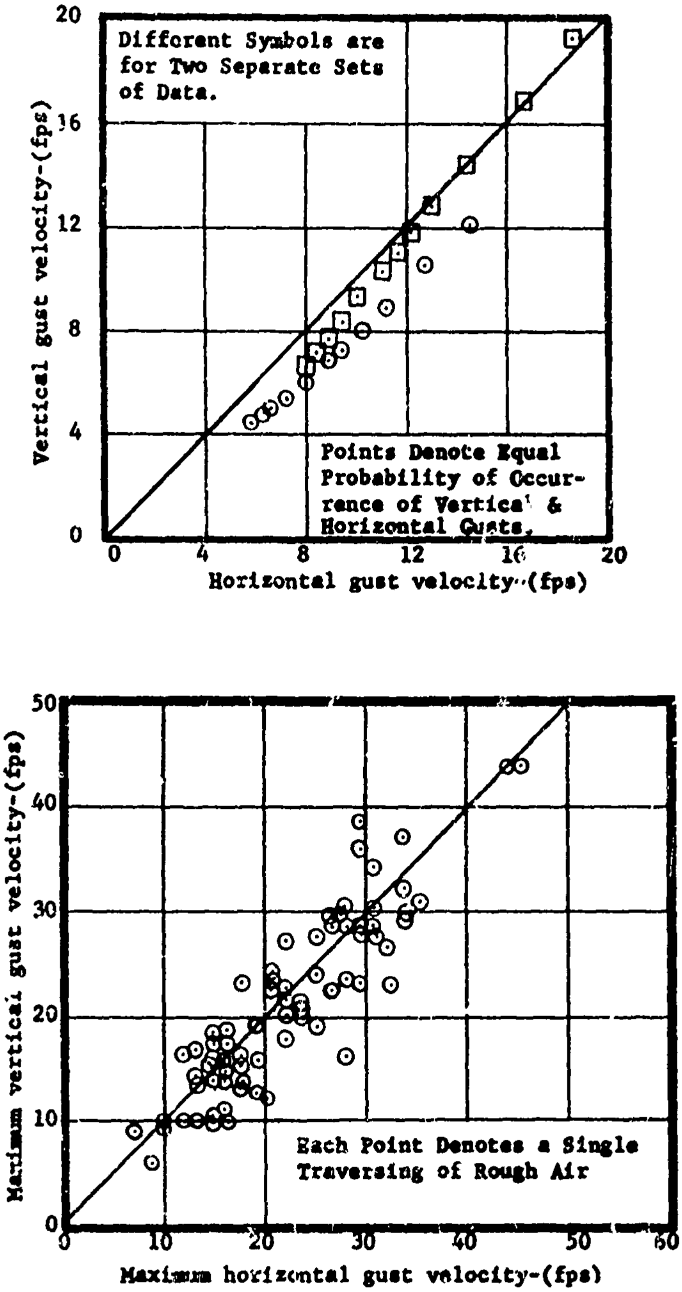


Figure 20. Horizontal and Vertical Gust Relationship

turbulence then the effective gust velocities. The ratio of the derived to the effective gust velocity also differs for the same turbulence at different altitudes, because the airplane mass ratio--defined below--is a function of air density. Since the revised gust-load formula is now being used in the routine evaluation of gust data, the large amounts of effective gust velocity data available from V-G records on civil transport airplanes from 1933 to 1950 were converted to derived gust velocities and are summarized in Reference 3.

In comparing derived ($U_{de}$) and effective ($U_e$) gust velocities, it may be seen that the two gust velocities differ only in regard to the factors K and $K_g$.

$$U_{de} = \frac{2\ a_n\ {}^{W}/_{S}}{\rho_o m\ V_e K_g}\text{, fps; and } U_e = \frac{2\ a_n\ {}^{W}/_{S}}{\rho_o m\ V_e K}\text{, fps.}$$

where:

$a_n$ = vertical or normal acceleration (g units)

$W$ = airplane weight (lb)

$S$ = wing area ($ft^2$)

$m$ = slope of wing lift curve, ($radian^{-1}$)

$V_e$ = equivalent airspeed (fps)

$K$ = gust alleviation factor (function of W/S) (See Figure 21)

$K_g$ = gust factor (function of $\mu_g$) (See Figure 21)

$\mu_g$ = airplane mass ratio $\dfrac{2\ W/S}{\rho_g\ m\ c}$

$\rho$ = mass density of air ($slugs/ft^3$)

$\rho_o$ = mass density of air at sea level ($slugs/ft^3$)

$g$ = acceleration due to gravity ($ft/sec^2$)

$c$ = mean wing chord (ft)

The effective gust velocities may accordingly be converted to derived gust velocities simply by the relation:

$$U_{de} = U_e \frac{K}{K_g}$$

All values given in this report are for <u>derived gust velocities</u>.

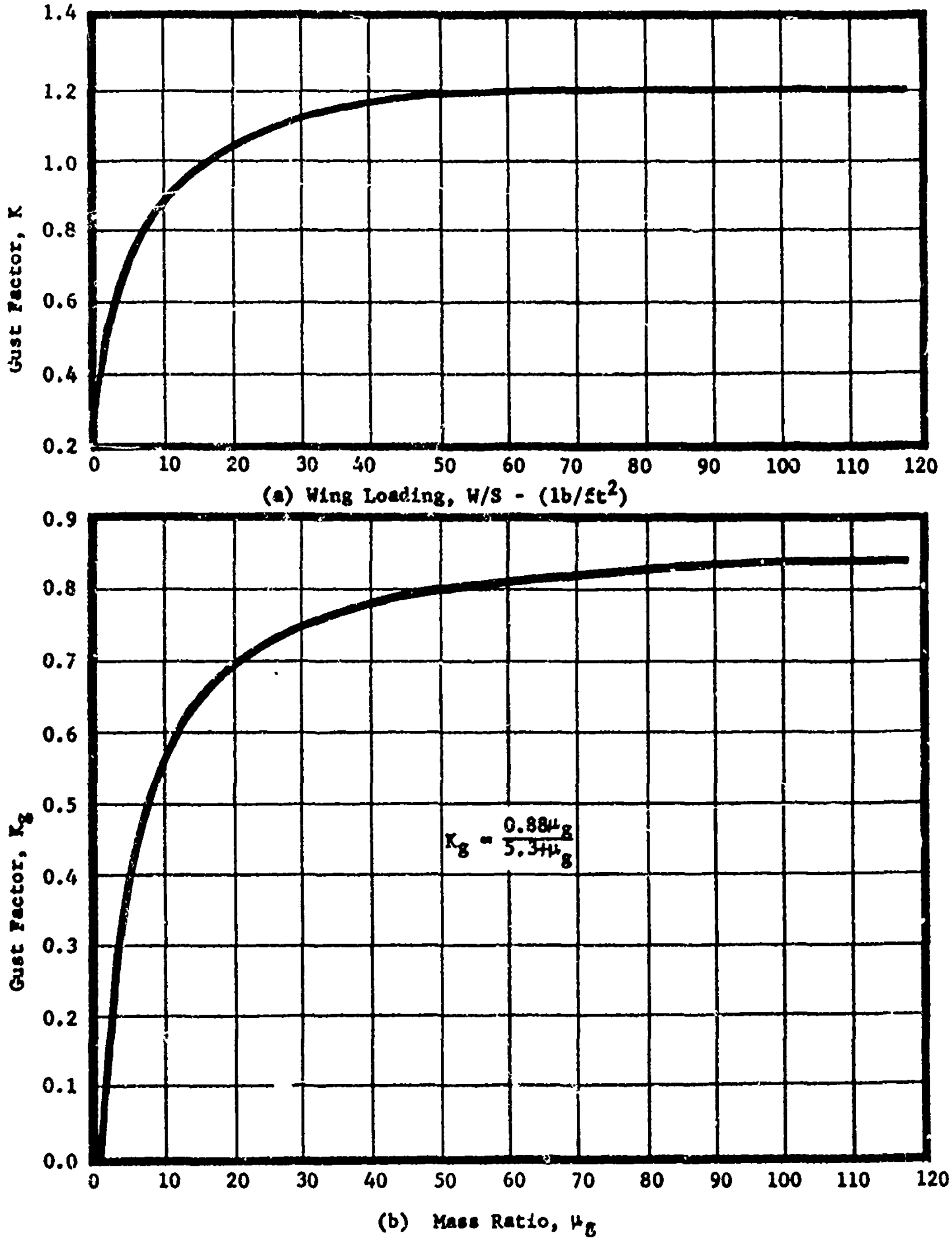


Figure 21. Gust Factors

The form of gust assumed in determining the derived gust velocity is:

$$u(t) = U_{de} \, \frac{1}{2} \, (1 - \cos \omega_o t) \qquad \text{for} \quad o < t < \frac{2\pi}{\omega_o}$$

$$u(t) = o \qquad \text{for} \quad o > t > \frac{2\pi}{\omega_o}$$

where

$U_{de}$ = derived gust intensity (ft/sec)

and $\omega_o$ = the frequency of the cosine (rad/sec)

Obviously, the time to reach the peak gust intensity is one half the period of the cosine:

$$t_1 = \frac{\pi}{\omega_o} \text{ (sec)}$$

The gust gradient distance X is a measure of the gust size in feet and is independent of any parameters of the measuring technique on means. The half cycle period is inversely proportional to the speed with which the gust is traversed and is, therefore, also given by

$$t_1 = \frac{X}{U_o} \text{ (sec)}$$

where $X$ = the gust gradient distance (ft)

$U_o$ = the velocity at which the gust is tranversed (ft/sec)

Equating the two expressions for the half cycle period gives

$$\frac{X}{U_o} = \frac{\pi}{\omega_o}$$

from which the frequency $\omega_o$ is seen to be

$$\omega_o = \frac{\pi}{X} \; U_o$$

Frequency of Gust Occurrence

Much of the published data on gust occurrences is obtained from flights made during weather periods involving severely turbulent atmospheric conditions such as thunderstorms. It is misleading, therefore, to present

frequence of occurrence values obtained from these records as being representative of conditions in general. On the other hand, the effects of gusts that are associated with the severely turbulent periods are the more important. Defining turbulence as any condition in which gust velocities exceed 1.64 fps (0.5 meters per second), the percentage of flight time in both thunderstorm and nonthunderstorm turbulence has been obtained (4). Table 3, from Reference 5, presents these data and should be used in conjunction with the data of Table 6.

TABLE 3

OCCURRENCE OF TURBULENCE

| APPROXIMATE ALTITUDE (ft) | PERCENTAGE OF FLIGHT TIME IN TURBULENCE | |
|---|---|---|
| | NONTHUNDERSTORM | THUNDERSTORM |
| < 10,000 | 18.0 | 0.10 |
| 10,000 - 20,000 | 6.4 | 0.11 |
| 20,000 - 30,000 | 4.5 | 0.062 |
| 30,000 - 40,000 | 3.9 | 0.0067 |
| 40,000 - 50,000 | 3.4 | 0.0017 |
| 50,000 - 60,000 | 2.2 | -- |

It is apparent from Table 3 that, for a gust velocity threshold of 1.64 fps, turbulent air is encountered during a relatively small portion of the overall flight time, the region below 10,000 feet being the only exception. In this region, the influence of terrain and convective heating on the wind flow results in frequent occurrences of gusty (turbulent) conditions.

Data on the number of gusts encountered per mile of flight versus gust intensity have been obtained from numerous commercial flights. A consolidation of these data is shown as bands in Figure 22. The "general" band includes all flight time; but, being from commercial flights, involves normal thunderstorm avoidance. A curve representing commercial flights without thunderstorm avoidance would be slightly above the "general" bands. The fact that the data used in Figure 22 came from a wide range of commercial routes and various altitudes should be considered in the utilization of this information. Probabilities of occurrence* of gust intensities and

* See Page 8 for definition

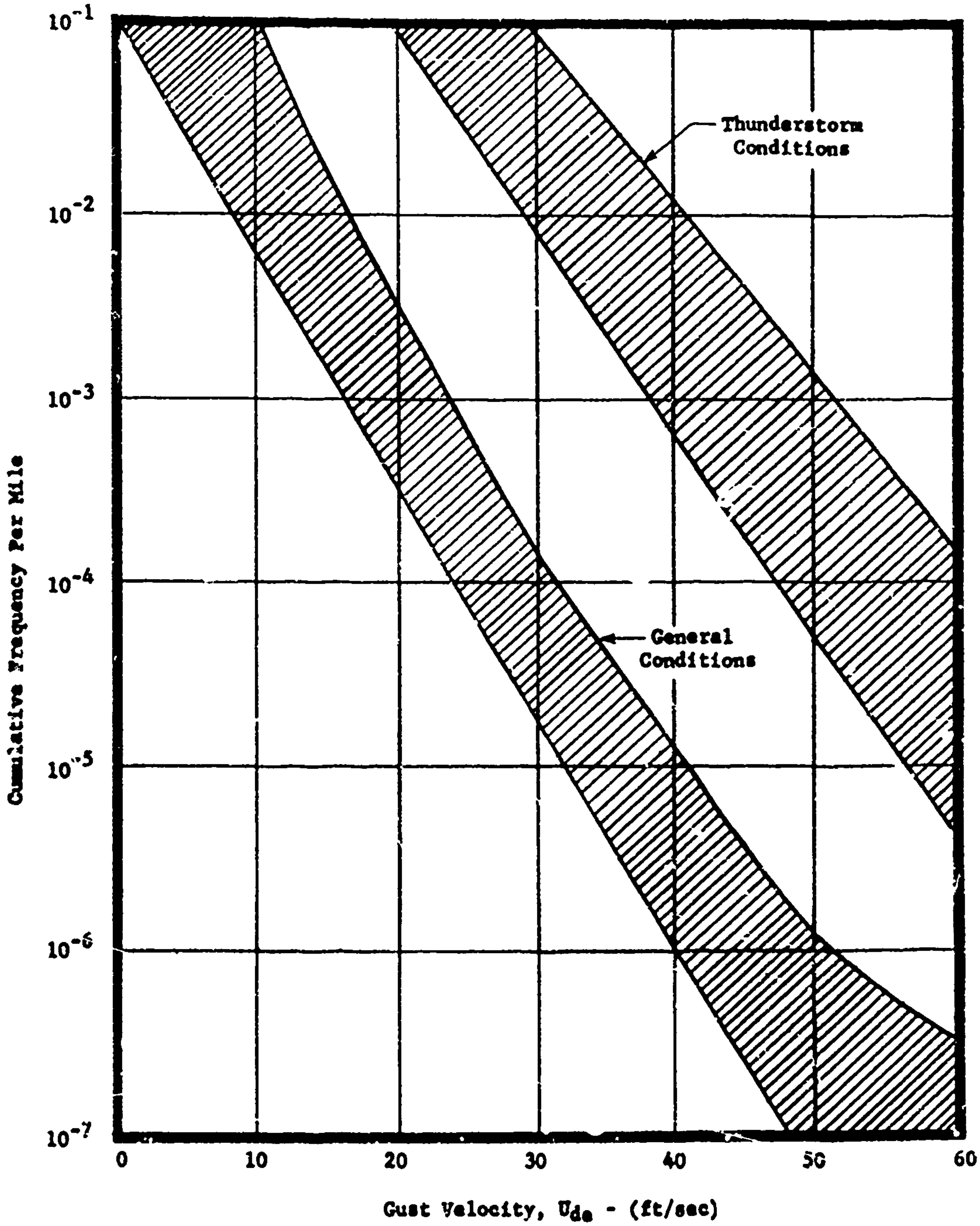


Figure 22. Cumulative Gust Frequency Per Mile of Flight.

gust gradient distances from a group of approximately six hundred gust measurements are presented in Table 4 as extracted from Reference 5. No direct statements could be found in the original reference containing these data (1) regarding the altitude range, weather conditions, or flight miles represented. However, from discussions in the report, the altitude range is assumed to be below 16,000 feet and it appears that thunderstorm turbulence observations are included.

TABLE 4

DISTRIBUTION OF GUST VELOCITY AND GUST GRADIENT DISTANCE
(Associated with the data of Figure 24)

| DISTRIBUTION OF GUST VELOCITY | | | | | | |
|---|---|---|---|---|---|---|
| Probability of Occurrence (%) | 50 | 20.0 | 10.0 | 5.0 | 1.0 | 0.1 |
| Gust Velocity (ft/sec) | 13.1 | 21.0 | 26.8 | 32.9 | 47.9 | 74.0 |
| **DISTRIBUTION OF GUST GRADIENT DISTANCE** | | | | | | |
| Probability of Occurrence (%) | 50 | 20.0 | 10.0 | 5.0 | 1.0 | 0.1 |
| Gradient Distance (ft) | 160 | 133 | 162 | 184 | 222 | 249 |

An interesting note on the vertical extent of turbulent layers, as determined from telemetered records, is contained in Reference 4. A graph reproduced from this reference is shown in Figure 23. The telemetered records were obtained from parachute-borne instruments called "gustsondes" and were collected at several locations in the United States over a period of one year. The data, which were grouped in intervals of 200 feet, indicate that the majority of the turbulent areas have a thickness of less than 800 feet. These thicknesses, which do not have the same meaning as gust gradient distance, were determined by noting the portion of the telemetered record indicating that the "gustsonde" was continuously disturbed and contained gusts equal to or greater than the reading threshold of 1.64 fps. The results give thicknesses or distances of gust action and should not be confused with the gust gradient distance previously defined.

Gust Gradient Distance

Published information on gust gradient distances is limited, but from the data available it appears that there is no correlation between gradient distance and gust intensity. A summary of gust gradient distances in the altitude range from 5,000 to 26,000 feet during periods of thunderstorm

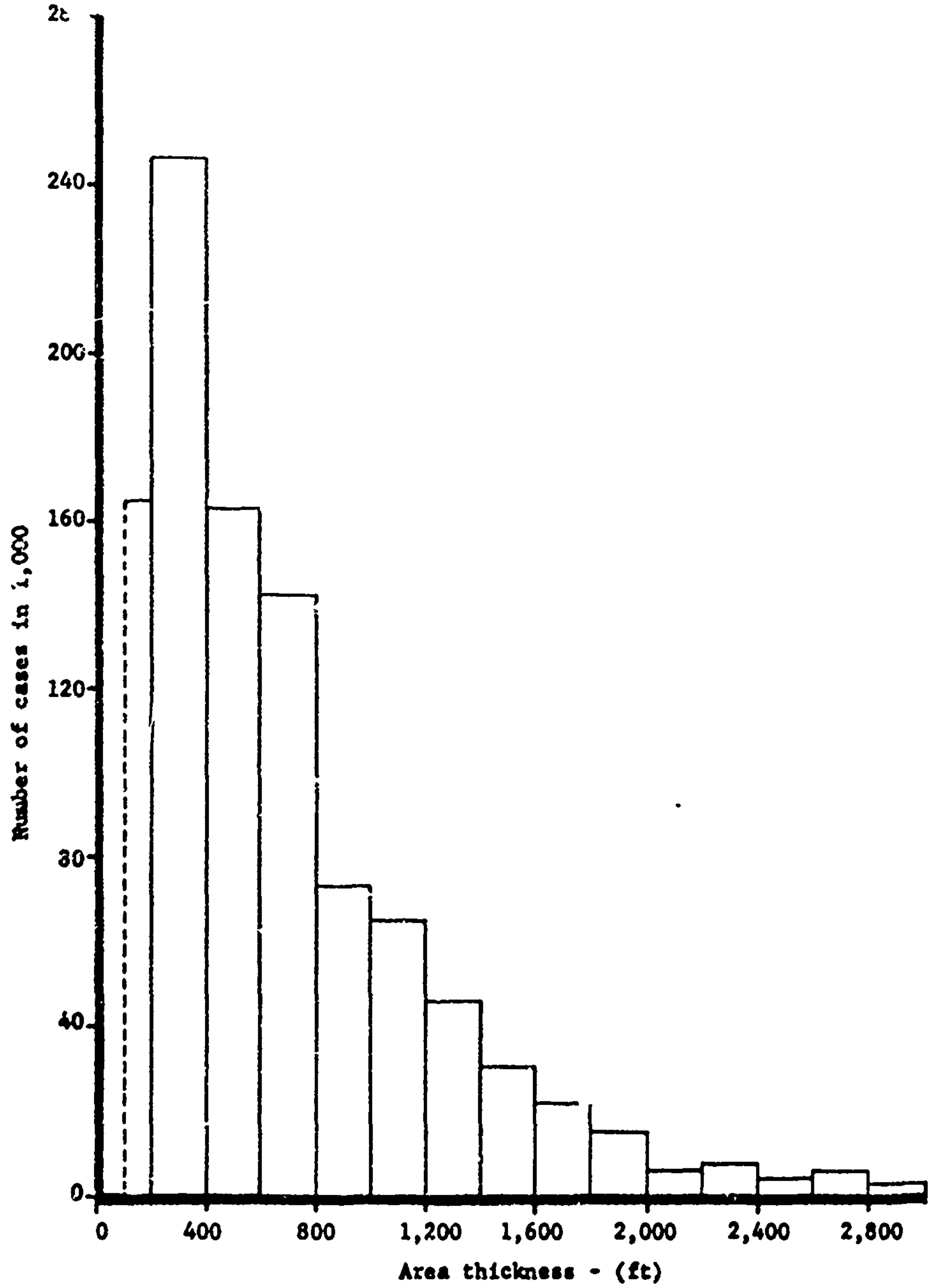


Figure 23. Variation in Thickness for Areas of Nonthunderstorm Turbulence

activity, taken from References 5 and 6, is presented in Table 5. This table is based on approximately 18,000 observations. The values given are higher than those of Table 4 because Table 5 represents thunderstorm conditions only whereas Table 4 simply includes thunderstorm conditions.

TABLE 5

DISTRIBUTION OF GUST GRADIENT DISTANCE
(5,000 to 26,000 foot altitude range)

| | | | | | | |
|---|---|---|---|---|---|---|
| PROBABILITY OF OCCURRENCE (%) | 50 | 20 | 10 | 5 | 1 | 0.1 |
| GRADIENT DISTANCE (ft) | 118 | 205 | 255 | 300 | 416 | 530 |

A scatter diagram, shown in Figure 24, plots peak gust velocity against gust gradient distance; and shows that the bulk of the gradient distances observed are between 40 and 200 feet with peak gust speeds generally below 30 fps (1). A figure of 43 fps has been presented by Sissenwine (7) as a representative 1% probability of occurrence value of the 610 gusts included in Figure 24 with a gust gradient distance of less than 30 feet attained by 1% of the gusts (i.e. 99% probability of occurrence value of gust gradient distance is 30 feet).

Distribution of Atmospheric Gust Velocities

Data on gust velocities as a function of altitude are summarized in Table 6 (5, 6, 8, 9, 10, 11). Also included in this table, in parentheses, is the average number of gusts per 1,000 feet of horizontal distance which exceed the indicated velocities (frequency of occurrence). A graphic presentation of the velocity data is provided in Figures 25 and 26. It is emphasized that the probability of occurrence distributions obtained for the gust velocities apply only to conditions of turbulent air as defined by the threshold value of gust velocity (1.64 fps); and therefore, do not include periods of near zero gust magnitudes. The influence of this condition on the interpretation of gust velocity distributions was discussed in a preceeding paragraph.

The selection of the particular percent probability of occurrence levels shown in Table 6 and Figures 25 and 26 was dictated by the requirements of the ABMA Aeroballistics Laboratory from whose report (5) the data were taken. The table is presented here mainly to show the relationship of thunderstorm gust conditions with those associated with clear air turbulence. Some important features to be noted from Table 6 are the low frequency of occurrence for nonthunderstorm associated gusts compared to thunderstorm values at the same altitude and probability of occurrence, and the change in gust frequency of occurrence with increase in altitude for nonthunderstorm conditions. A

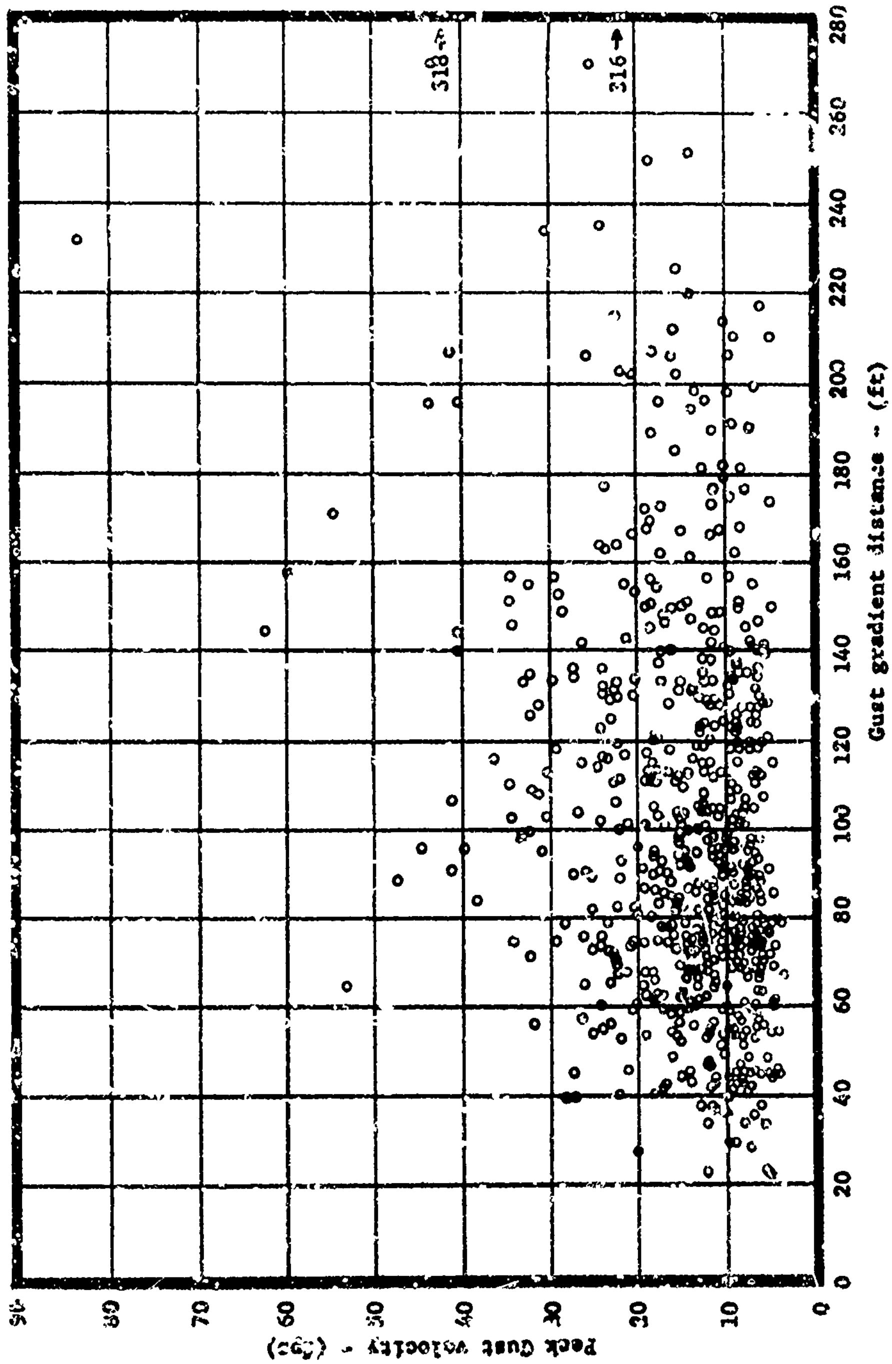


Figure 24. Gust Velocity as a Function of Gust-Gradient Distance.

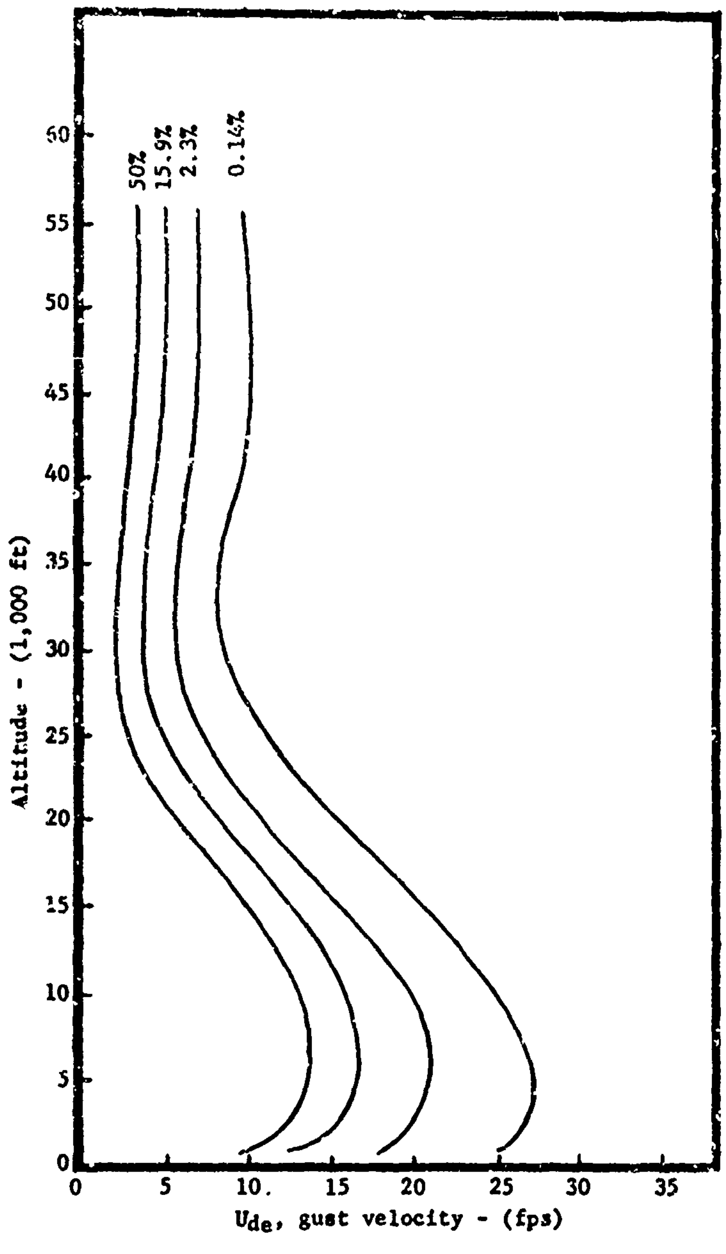


Figure 25. Nonthunderstorm Gust Probability of Occurrence.

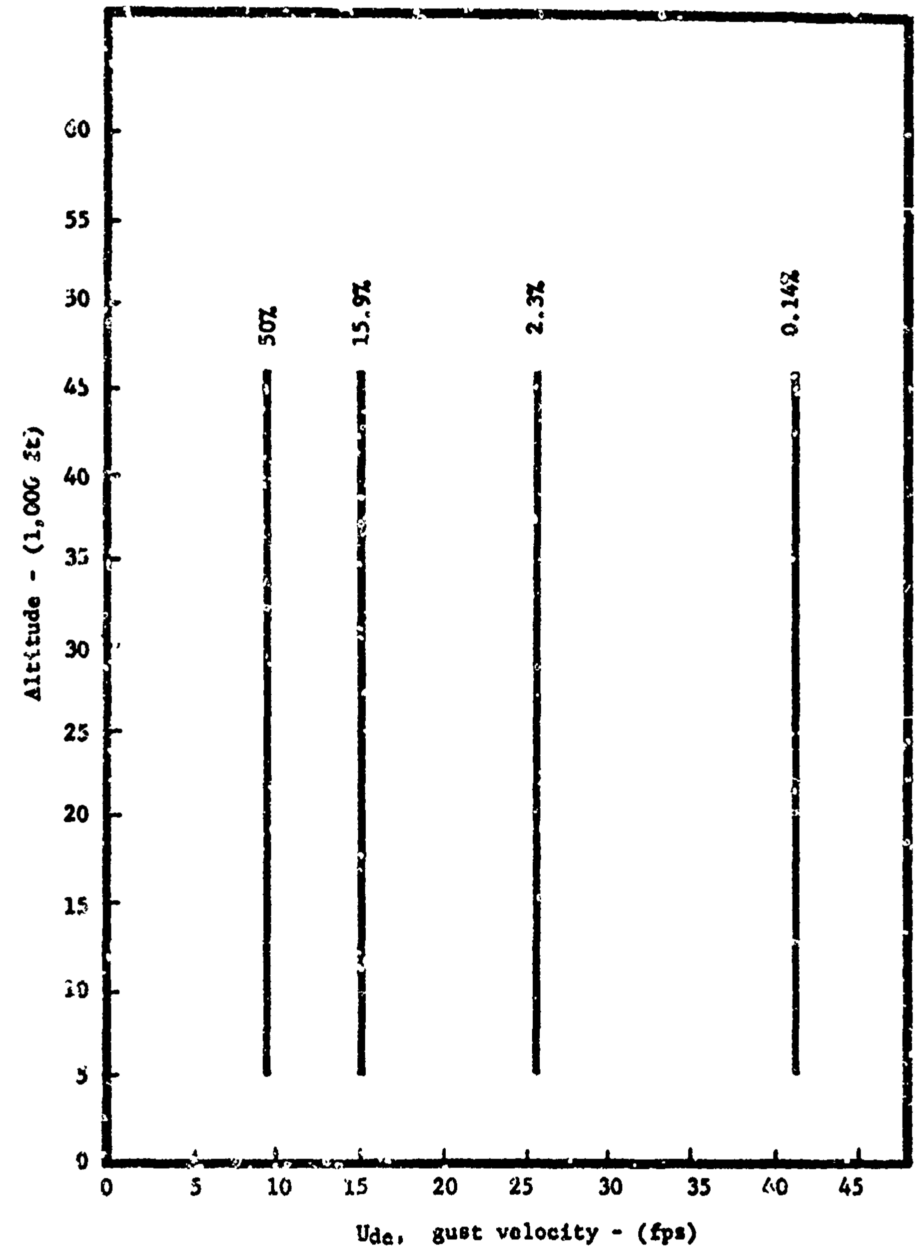


Figure 20. Thunderstorm Gust Probability of Occurrence.

general interpretation of the data presented in the table may be illustrated by the following example. For nonthunderstorm associated gusts in the 20,000 to 30,000 foot altitude range, 50% of the gusts which occur above 1.64 fps may be expected to equal or exceed 2.62 fps and one such gust may be expected to occur each 100,000 feet of horizontal flight.

TABLE 6

SUMMARY OF GUST VELOCITY DISTRIBUTION AS A FUNCTION OF ALTITUDE

| ALTITUDE FEET | THUNDERSTORM 50% * | THUNDERSTORM 0.14% | NONTHUNDERSTORM 50% | NONTHUNDERSTORM 0.14% |
|---|---|---|---|---|
| | (ft/sec) ** | | | |
| < 10,000 | 7.87(0.6) | 41.0(0.001) | 13.1 (0.006) | 26.2 (0.0003) |
| 10,000 - 20,000 | 7.87(0.6) | 41.0(0.001) | 8.52(0.002) | 19.0 (0.00007) |
| 20,000 - 30,000 | 7.87(0.6) | 41.0(0.001) | 2.62(0.01) | 11.5 (0.0002) |
| 30,000 - 40,000 | 7.87(0.6) | 41.0(0.001) | 1.87(0.009) | 8.2 (0.0003) |
| 40,000 - 50,000 | 7.87(0.6) | 41.0(0.001) | 2.3 (0.003) | 9.18(0.0001) |
| 50,000 - 60,000 | 7.87(0.6) | 41.0(0.001) | 2.95(0.002) | 9.3 (0.00007) |

* = Probability of occurrence (percent)
** = Gust magnitude units

Gust velocities as related to altitude for various percent probabilities are shown in Figure 27. The raw data were accumulated from numerous reports (12, 13, 14 and others) which reported similar measurements made on several different aircraft used for commercial cross-country flights. The curves show the relative independence of gust intensity with respect to altitude for the lower (e.g. 5, 1, .1%) probabilities of occurrence. There is also a definite indication that at the higher (e.g. 10, 20, 50%) probabilities of occurrence the gust intensity tends to decrease in magnitude with altitude. These curves, compiled from data for average weather conditions, appear to be in good agreement with those of Figures 25 and 26 which give gust values for the extreme conditions.

## Ground and Low-Level Gust Conditions

Knowledge of low-level gusts is incomplete with data on the probability of occurrence and gradient distances being essentially nonexistent (13). There are, however, several references which include derived relationships between mean wind speeds and gust intensities. At the initiation of the

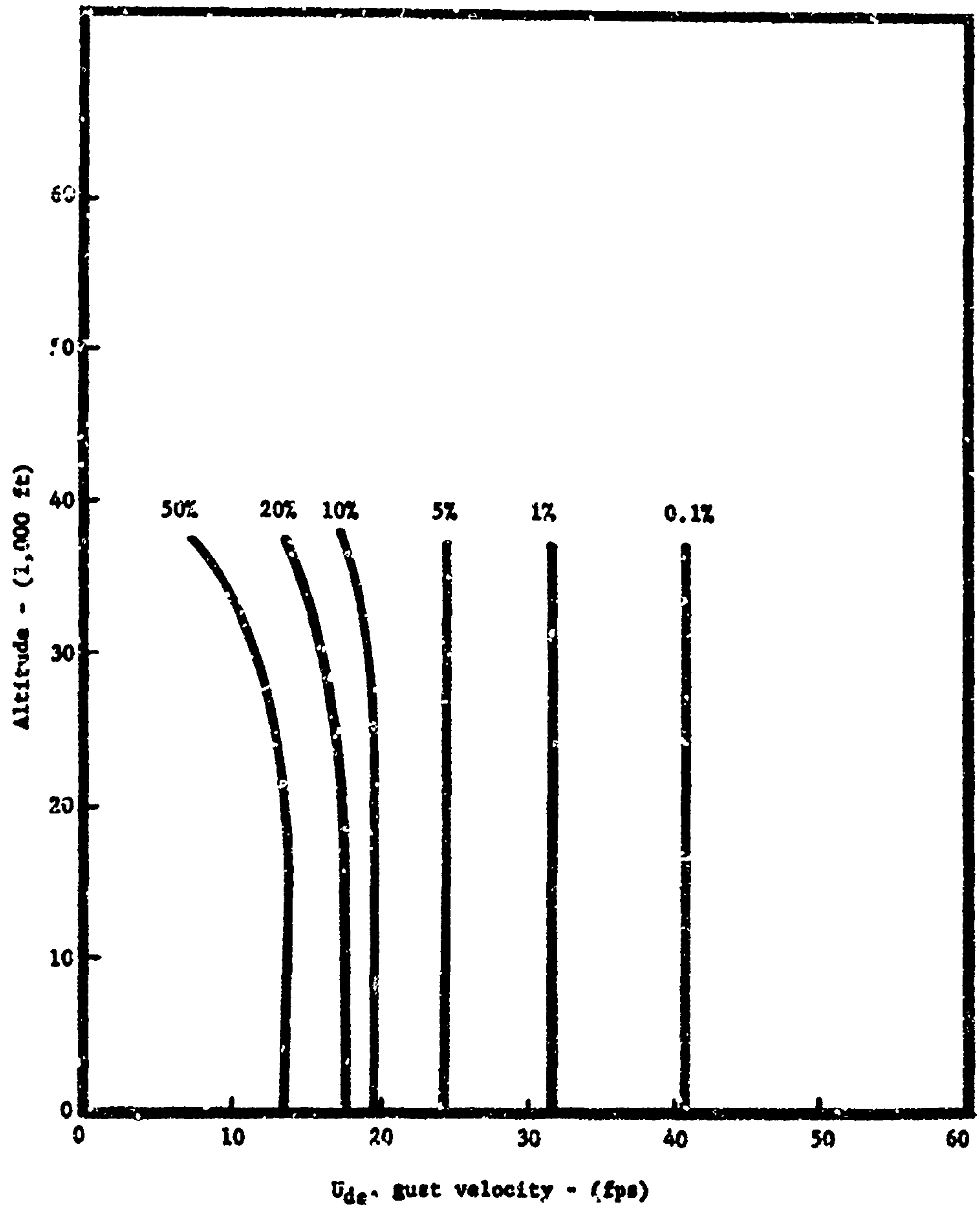


Figure 27. Average Gust Velocity Probability of Occurrence.

study program, it was thought that a great deal of useful information could be acquired from weather bureau records; but it was later found that the manner in which weather stations record and transmit gust information (16) results in data which is of little value for application to control system analysis. On the WBAN-10A form "Surface Weather Observations" used by all weather services in the United States for the recording of surface wind conditions, the average wind speed is recorded for a time period of one minute. Gusts are recorded as the average of the peak winds, during a period of 15 minutes, with the stipulation that only those peaks are considered for which the difference between the peak and its associated lull is at least 9 knots. It is further required that only those peaks are considered where the average time between peaks and lulls does not exceed 20 seconds. A peak gust is considered as, "The highest speed momentarily indicated, without regard to the duration of the gust." Thus we can see that the information currently logged, transmitted over weather teletypes, and stored at the National Weather Records Center (Asheville, North Carolina) is relatively unusable for control system analysis. Continuous traces of wind speed and direction are available at many weather stations, but unfortunately these records are normally disposed of a short period of time after recording. Generally no permanent record of such data is kept.

Any wind trace, continuous with time, reveals that wind is not constant either in direction or intensity. The variation of the wind is a function of the exposure of the wind sensor, the nature of the terrain, and the vertical temperature gradient or lapse rate. Gusty conditions are almost always associated with temperature regimes where the temperature decreases with height. Carruthers (17), Deacon (18), Robitzsch (19), and Sherlock (20), have all contributed to the knowledge of gust intensities in low-level winds. They established gust factors, which are the ratio of peak to average wind intensities, for wind peaks of two-second duration and height intervals of 40 to 125 feet. The average wind used as a reference was taken over five-minute averaging periods. These results are as follows:

| | | | | |
|---|---|---|---|---|
| Five-minute mean wind speed (ft/sec) | 34 | 50 | 67 | 85 |
| Most probable gust factor | 1.5 | 1.4 | 1.4 | 1.4* |
| Maximum gust factor | 1.9 | 1.8 | 1.7 | 1.8* |

Sherlock (20) also found that for altitudes less than 300 feet, the variation of peak wind speed, V, with height, Z, can be expressed by an exponential relation which, for ten-second gusts, is:

$$V/V_{30} = \left(\frac{Z}{30}\right)^{0.080}$$

where $V_{30}$ is the peak speed at the reference height of 30 feet.

---

* Extrapolated

Deacon (18) gives a similar expression for two-second gusts as:

$$V/V_{30} = \left(\frac{Z}{30}\right)^{0.085}$$

An expression which relates the gust factor, G, to altitude is given by Sherlock (21) for various gust durations:

$$G/G_{62.5} = \left(\frac{62.5}{Z}\right)^{n}$$

where $G_{62.5}$ is the gust factor at the reference height of 62.5 feet and n is a function of gust duration empirically determined as follows:

| Gust duration (sec) | 0.5 | 1 | 2 | 3 | 5 | 10 |
|---|---|---|---|---|---|---|
| n = | 0.09 | 0.08 | 0.071 | 0.065 | 0.058 | 0.048 |

Robitzsch (19) and Sherlock (20) computed height variation of peak wind speeds and gust factors for gusts of one minute and a few seconds duration. The results are shown below, where 10 feet is the reference level for the peak wind:

| HEIGHT (feet) | ONE-MINUTE GUSTS | | FEW-SECOND GUSTS | |
|---|---|---|---|---|
| | $V/V_{10}$ | G | $V/V_{10}$ | G |
| 300 | 1.33 | 1.5 | 1.32 | 1.4 |
| 100 | 1.29 | 1.5 | 1.21 | 1.5 |
| 50 | 1.22 | 1.5 | 1.14 | 1.5 |
| 20 | 1.10 | 1.5 | 1.05 | 1.6 |
| 10 | 1.00 | 1.5 | 1.00 | 1.7 |
| | (From Reference 19) | | (From Reference 20) | |

Use of the relations given with recorded weather data for any particular area of interest will provide a reasonably accurate value of the low-level gust intensities.

### Power Spectra

The intensity of wind in a turbulent region generally varies in a random fashion, and more specifically, is approximately Gaussian (22, 23, 24). For these reasons it is possible to apply generalized harmonic analysis techniques which reveal the statistical characteristics and power spectrum of the

turbulence. The power spectrum form of gust data indicates the gust or turbulent energy present at each frequency such that the integral of the power spectrum for all frequencies is simply the mean square of the gust intensity (23).* There are several problems associated with obtaining and interpreting data in spectrum form as described further in this section.

It may be well to examine the nature of turbulence in a rudimentary way to see, at least in theory, how its energy is related to frequency. The first consideration might be that of the term "frequency." Turbulence may be thought of as eddies of various sizes, within a mass of air, each of which has a characteristic length. The term "frequency" is a measure of the reciprocal of the characteristic length or the wave number. A hypothesis proposed by Taylor (25) states that in a homogeneous and isotropic field, the space variation of turbulence can be determined by considering the turbulent region at rest (or frozen) and moving the observer through the field with a relative velocity -U', where U' is the velocity of the air stream transporting the turbulence. Thesefore, if the mass of turbulent air has an average directional flow velocity or if a vehicle moves through the turbulence at some relative velocity, the measured frequency with which the wind intensity changes will increase proportionally.

Within the turbulence, energy is transferred from the larger eddies to smaller and smaller eddies until it is lost in viscous dissipation. Turbulence which is receiving no further energy from the mean flow tends to become isotropic, i.e., its statistical properties tend to become the same in all directions. In the frequency range where the turbulence is isotropic the form of the energy spectrum is postulated to depend only on the total rate of energy flux from the lower frequencies to the higher frequencies. The only dimensional form possible will then be: the energy per unit frequency is proportional to frequency raised to the minus five-thirds power, according to Kolmogorov (26). Theories of the spectrum shape at higher frequencies are immensely more complicated. In this small-eddy, "turbulent viscosity" range, Heisenberg (27) predicts an asymptotic spectrum decay proportional to frequency to the minus seventh power.

Of special interest to the designer of flight control systems is the low-frequency shape of the power spectrum. Unfortunately, this region is poorly defined due to the varied causes of large eddies and the lack of accurate measurements. The nature of laminar flow instability and its transition to turbulent flow is not well understood. There are sufficient measurements and heuristic arguments**, however, to indicate that a flattening of the power spectrum occurs at the lower frequencies in all cases.

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* In this report the mean square of gust intensity ($\sigma^2$) is always $\sigma^2 = \int_0^\infty \Phi(\omega)d\omega$ where $\Phi(\omega)$ is the power density spectrum and $\omega$ is in radians per second.

**For example, steady (zero frequency) winds are not unlimited in amplitude.

The form of the power spectral density of vertical gusts has been considered by various authors with each usually showing some agreement between his empirical or semi-empirical analytical expression and measured data. Decaulne (28) suggests the spectrum:

$$\Phi(\omega) = K \frac{U_o}{\omega^2} \qquad \frac{(\text{ft/sec})^2}{\text{rad/sec}}$$

over the frequency range of 0.5 rad/sec $\leq \frac{U_{ref}}{U_o} \times \omega \leq$ 10 rad/sec, where $U_o$ is the airplane speed, (ft/sec) $U_{ref}$ is the reference speed of 300 ft/sec, and K is a constant which varies with the strength of the turbulence. At lower frequencies $\Phi(\omega)$ will obviously approach infinity. Flodin and Sundstrom (30) consider two approximations to use with Decaulne's expression which provides the desired low frequency limits. One is simply to consider the spectrum a constant below some frequency $\omega_o$, and the second is to assume a second degree parabola tangent to Decaulne's spectrum at $\omega_o$:

$$\Phi(\omega) = 3K \frac{U_o}{\omega_o} 4 \left( \frac{4}{3} \omega_o \omega - \omega^2 \right) \quad \frac{(\text{ft/sec})^2}{\text{rad/sec}}$$

Liepmann (29) suggests the spectrum:

$$\Phi(\omega) = \sigma^2 \frac{L}{\pi U_o} \quad \frac{1 + 3\lambda^2}{(1 + \lambda^2)^2} \quad \frac{(\text{ft/sec})^2}{\text{rad/sec}}$$

where $\sigma$ is the mean intensity of the vertical gust, L is the "scale of turbulence" ($L/U_o$ denotes half of the least time shift for which the autocorrelation function equals zero) (29), and $\lambda = \frac{L\omega}{U_o}$. This spectrum form is bounded at all frequencies including zero. Actually there are few measurements to indicate the shape of gust spectra at the lower frequencies and the accuracy of those measurements which are available is questionable. An error in the low frequency end of a spectrum result in essentially the same order of error in the mean square valve of intensity. These two factors are the major shortcomings of utilizing gust power density spectra in control system analyses.

Lateral gusts are assumed to have the same form as the vertical gusts but the expression developed (29, 31) for longitudinal or fore-and-aft gusts is:

$$\Phi(\omega) = \sigma^2 \frac{L}{\pi U_o} \quad \frac{2}{1 + \lambda^2} \quad \frac{(\text{ft/sec})^2}{\text{rad/sec}}$$

The spectrum equations given are presented in the literature in several variations. Dividing both sides of Liepmann's expressions by $\sigma^2$, for example, gives a normalized spectrum which only indicates the spectrum shape as a function of frequency. Values of L between 200 and 1,000 feet than give

good agreement between these expressions and measured data, (29, 32, 33, 34, 35 and others). A value of the scale of turbulence, L, of 500 feet is suggested by Etkin(31) to approximate the wealth of B-66 data (33). He also suggests a mean square value of 9 $(fps)^2$ for vertical gusts and 11.5 $(fps)^2$ for fore-and-aft gusts to approximate these data. However, the spread of data in each case is large and these values may not be conservative enough for flight control system design. (MIL-A-8866 spectra are essentially of the same shape but slightly greater than those suggested by Etkin.)

Multiplication of the power spectrum by the aircraft velocity (34) changes the dimensions of the "frequency" from radians per second ($\omega$) to radians per foot ($\Omega$) where $\Omega = \frac{\omega}{U_o}$. The spectrum is then

$$\Phi(\Omega) = U_o \, \Phi(\omega) \; \frac{(\text{ft/sec})^2}{\text{rad/ft}}$$

and

$$\sigma^2 = \int_0^{\infty} \Phi(\Omega) \, d\,\Omega$$

Much of the data available is presented in this form to make it independent of the aircraft speed. Measured values of several typical power spectra are shown in Figure 28 together with several analytical approximations. The analytical approximations have been shifted in the vertical direction to give rough agreement with the measured data. (This shift is equivalent to a change in the mean gust intensity in the case of the Liepmann expression.)

Estimates of the spectra for span-wise gusts have been made by Notess (34) for the difficult low altitude case. Results indicate that a modified Liepmann expression is applicable; but "additional checks are needed to make any conclusions definite, and to investigate how L can be estimated."

If turbulence is not isotropic, there may be a relationship between the phasing of the orthogonal gust components. Knowledge of the phase relationship may be necessary in calculating the response to combined gusts. Evidence of correlation between the phasing of vertical and fore-and-aft gust components has been noted for frequencies in the phugoid range (36).

The question of the probable intensity ($\sigma$) of a gust power spectrum has received little study. Donely (37) presents information of this type which was derived by Press from load factor increment occurrence values for clear air. These data are shown in Figure 29, but similar data for convective clouds or very low altitudes are not know to exist. The gust occurrence values presented in this section, however, can be used to approximate similar data for various weather and altitude conditions. Panofsky (38) gives the root-mean-square wind intensity for low altitudes as:

$$\sigma = 0.226 \, \frac{V}{\log h/h_o} \quad (\text{ft/sec})$$

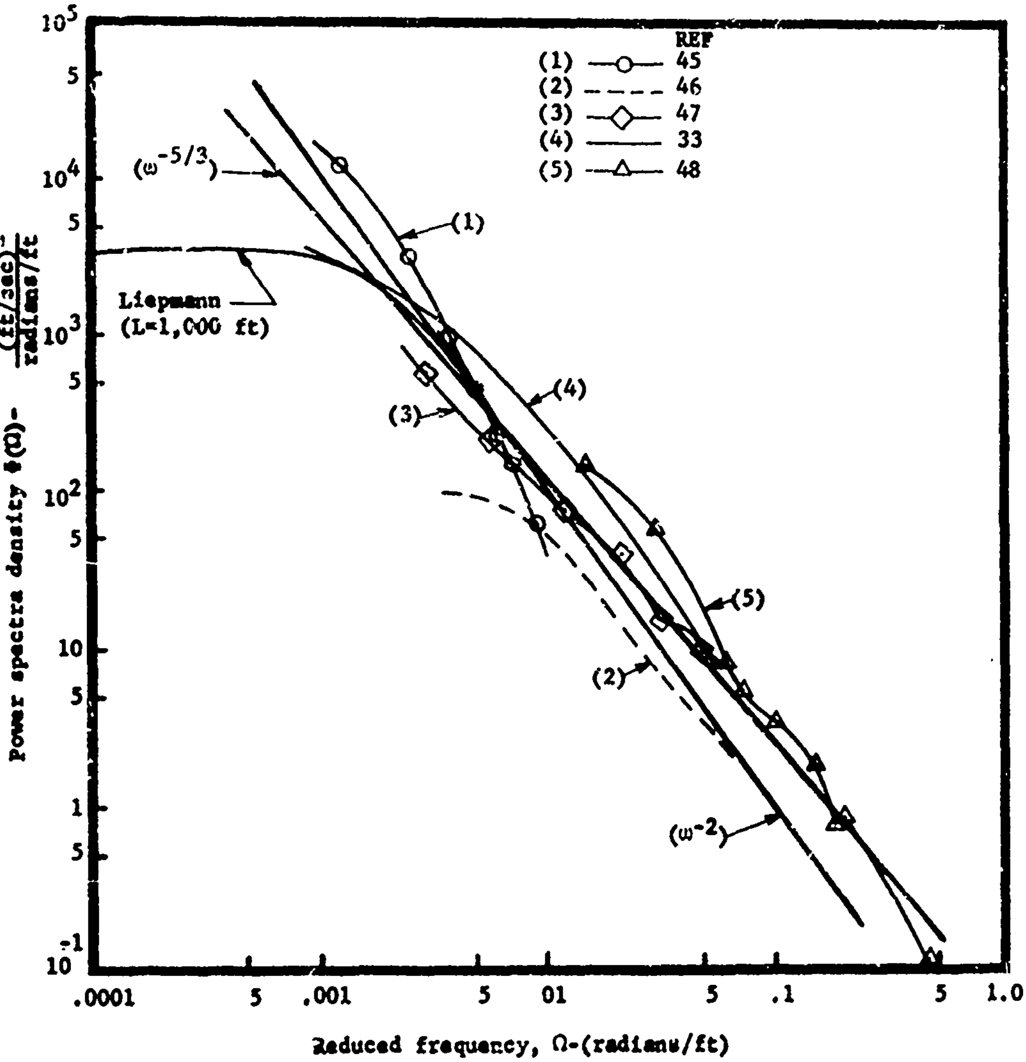


Figure 28. Analytical and Measured Gust Power Spectra Data

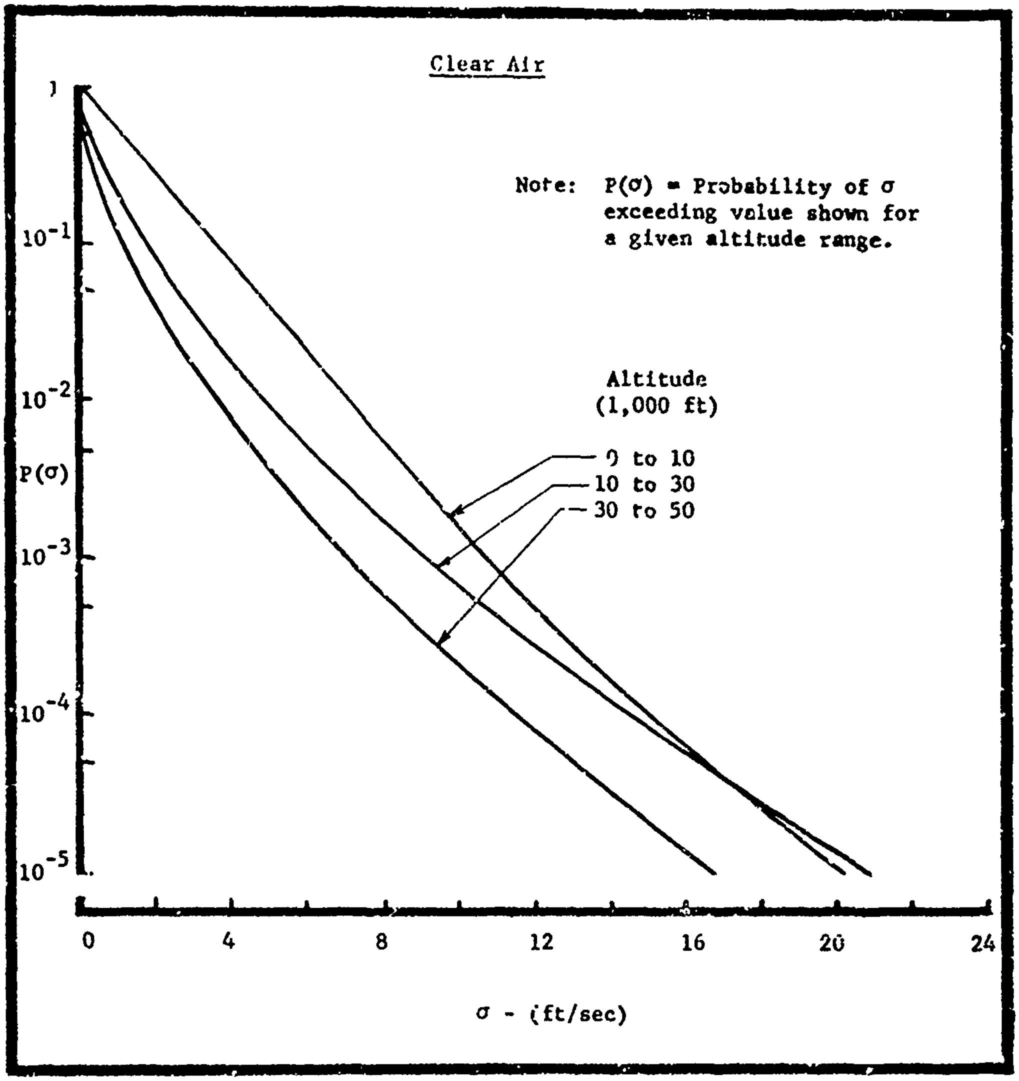


**Figure 29.** Cumulative Probability Distributions of Root-Mean-Square Gust Velocity

Where V is the mean wind speed in feet per second at height h in feet, and $h_0$ in feet is the characteristic roughness length. He also indicates that the value of L in Liepmann's vertical gust spectrum equation is 0.93h at low altitudes, up to 1,000 feet.

Low altitude turbulence has been investigated to some degree and gust power spectrum densitites obtained (31, 32, 34, 38). The properties of homogeneity, isotropy, and stationarity in low-level gusts are, however, highly questionable. Etkin (31) states, "In spite of this, there would seem to be no recourse, in the present state of the subject, but to use the isotropic model for the low-level case as well as the high altitudes. The complexity of the problem is even then quite sufficient!" One of the factors contributing to the problem of establishing low-level gust spectra is the influence of terrain. Turbulence over the Sierra Nevada mountains (39), for example, demonstrates non-homogeneities to an altitude of several thousand feet. High intensities appear in the power spectra at low frequencies because of the persistent vertical mountain waves.

The general intensity of low-level turbulence is also influenced by terrain. Lappe (36) presents data which indicate that over highly irregular terrain, gust intensity averages for one mile segments tend to follow the profile features of the terrain. This not only indicates that the energy maxima follow the large scale terrain features but also that the energy maxima are not transported by the mean flow. By contrast, turbulent energy is carried out to sea by the mean flow for distances of three to four miles.

## Use of Power Spectra

Knowledge of the power spectrum of the gust disturbance, together with knowledge of the transfer function, G(S), with S the Laplace operation, from the variable of concern to the gust input, will permit determination of the power spectrum density of this variable due to the gust input by:

$$\Phi_o(\omega) = \left|G(j\omega)\right|^2 \quad \Phi_i(\omega)$$

where $\Phi_o(\omega)$ is the power spectrum of the variable of concern and $\Phi_i(\omega)$ is the power spectrum of the gust (40, 41, 42). An empirical gust spectrum form, suggested by the authors, is the following:

$$\Phi(\omega) = \sigma^2 \frac{L}{U_o} \frac{1}{(1+\lambda)^2}$$

where again

$$\sigma^2 = \int_0^\infty \Phi(\omega) \, d\,\omega$$

There is no theoretical basis for this form; but its agreement with measured spectra, the preservation of the parameter, L, to account for low-level altitude and other variations, and its simplicity suggest its use.

## Discrete Gust Shapes

Individual or discrete gusts are seldom encountered in practice, but their consideration is useful for design purposes. As stated previously, single, triangular gust wave shapes were assumed in estimating "effective" gust velocities, with single period, one-minus-cosine shapes being used in estimating "derived" gust velocities from acceleration data. Specifically, the wave length for the one-minus-cosine wave shape is taken as twenty-five chord lengths whereas the triangular shape was taken to be twenty chord lengths (2). Sharp edged gusts, wherein the vertical wind velocity is assumed to change in a step fashion, are also useful in analysis (43) but are essentially non-existent in practice.

The assumption of a one-minus-cosine gust shape is credible in view of the "eddy" nature of gusts and the characteristics of measured gusts, which indicate that the spatial and time rate of change of wind intensities are always finite. The period of the one-minus-cosine shape, however, should be given careful consideration. Obviously when the vehicle under examination has no wings a specification of the gust length in terms of chord lengths has no meaning and some other criterion must be used. As previously shown, the gust gradient distance and intensity are essentially independent. The probability of achieving any plausible gust length, for some given intensity, is relatively high. From this argument, it appears that the period of the one-minus-cosine gust which should be assumed is that which produces the most critical response. It is convenient to speak of the "frequency" of the one-minus-cosine gust where the frequency, $\omega_0$, is defined as $2\pi$ times the reciprocal of the period. Using this nomenclature, the critical frequency will usually be found to be that which corresponds to some natural frequency in the vehicle. In the case of a missile this might be a slosh frequency or a body bending frequency. In an aircraft it might correspond to the short period response frequency.

To indicate the importance of selecting the "frequency" of an assumed discrete gust, the peak transient amplitude of a second order system was measured when excited by a one-minus-cosine forcing impulse. A plot of the normalized peak amplitude as a function of the ratio of gust frequency to the undamped natural frequency is shown in Figure 30 for a system having a damping ratio of 0.2. If this system were subjected to a one-minus-cosine excitation, where the frequency of the excitation was three and one-half times the undamped natural frequency, it is seen from the curve that the peak amplitude during the resulting transient is only half the magnitude that would result if the frequency of the excitation equaled the natural frequency. For this simple second order system, used only as an example, the maximum value of the normalized amplitude occurs at a frequency ratio of one when the damping is less than critical. A curve of the maximum normalized amplitude as a function of damping ratio for this case is shown in Figure 30. As damping is decreased the maxima naturally increase. The one-minus-cosine excitation, being essentially an impulse, limits the input energy; and, therefore, the peak response amplitude.

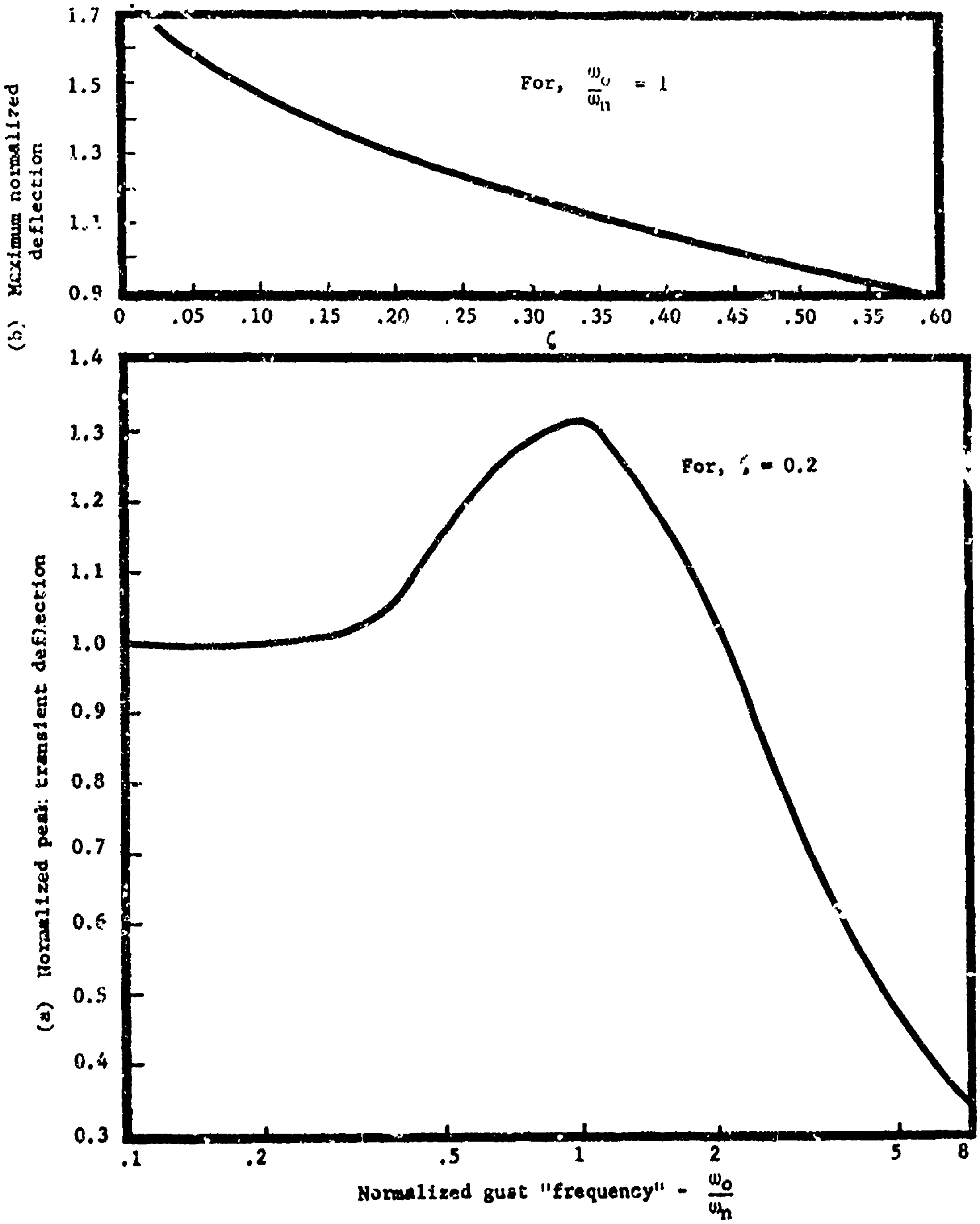


Figure 30. Normalized Amplitude Curves.

A final characteristic, which is useful in control system analysis, is the Fourier transform of the one-minus-cosine disturbance shape. Specifically, if the gust is given by

$$u(t) = U_{de} \frac{1}{2} (1 - \cos \omega_o t) \qquad 0 < t < \frac{2\pi}{\omega_o}$$

$$u(t) = 0 \qquad 0 > t > \frac{2\pi}{\omega_o}$$

the Fourier transform is given by

$$U(j\omega) = U_{de} \frac{\pi}{\omega_o} \left( \frac{1}{1 - \left(\frac{\omega}{\omega_o}\right)^2} \right) \left( \frac{\sin \left(\pi \frac{\omega}{\omega_o}\right)}{\pi \frac{\omega}{\omega_o}} \right) e^{-j\left(\pi \frac{\omega}{\omega_o}\right)}$$

From this expression and knowledge of the transfer function of the system, the transform of the response of the system may be obtained (44). A plot of the Fourier transform magnitude, as a function of the ratio of frequency to the frequency of the gust form, is presented in Figure 31. It is conjectured that the summation of frequency characteristics of a number of one-minus-cosine impulses, with appropriate consideration of their magnitudes and periods, will give a good approximation to the spectrum characteristics of random turbulence.

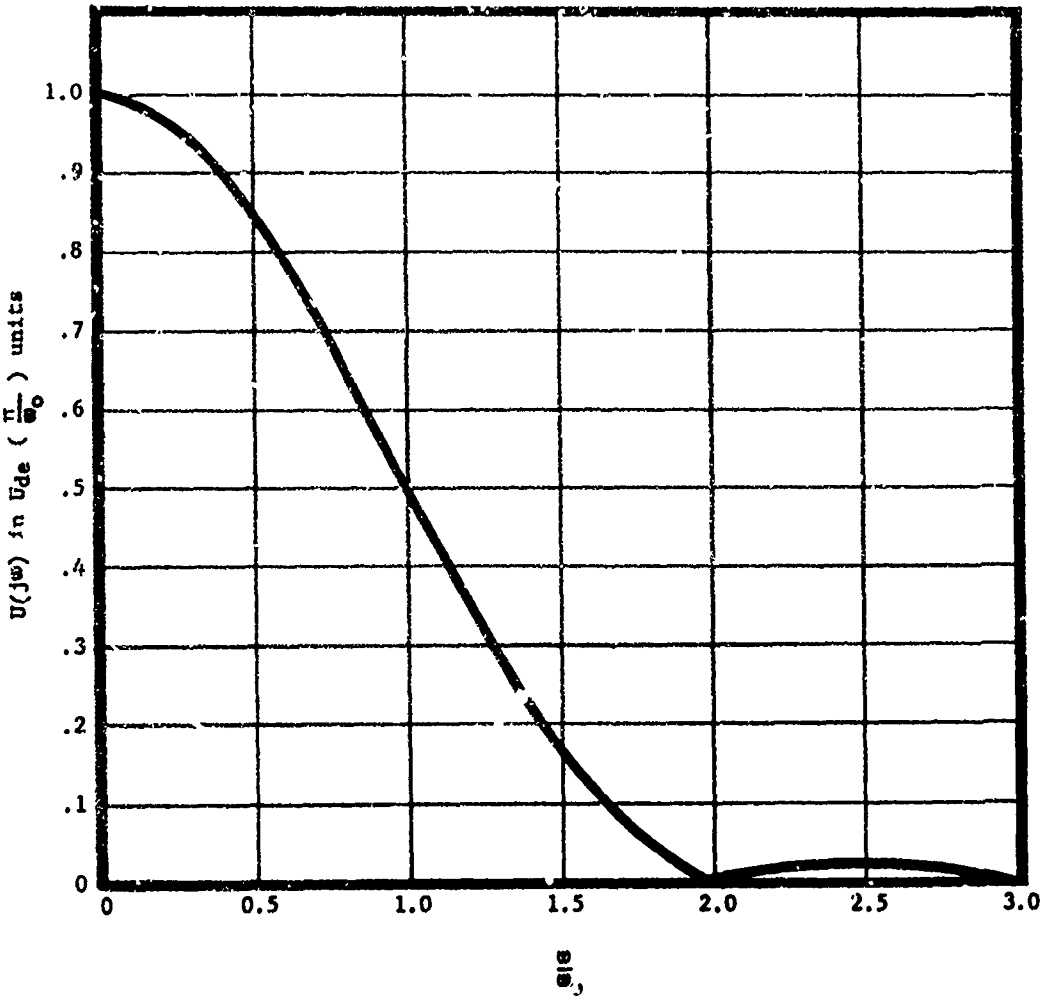


Figure 31. Frequency Content of 1-cos Impulse

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## THRUST IRREGULARITIES

Disturbances to the attitude and flight path of a conventional aircraft resulting from irregularities in thrust of the main engines are usually of a nature that their elimination is accomplished manually. The thrust of the main engines or control motors of an unmanned missile, on the other hand, may be uncontrolled or inaccurately controlled. Any thrust irregularities which exist may significantly disturb the flight path or attitude of the missile. Specific data on the nature or magnitude of such irregularities are usually supplied only in part in the manufacturer's specifications or performance manuals for rocket engines or motors. Those values which are given are usually three times the mean deviation of the factor's random variation. In a few cases the thrust irregularities of engines have been measured in detail in connection with the design of flight control systems for particular missiles, but no general programs are known in which an attempt has been made to compile statistical data on the magnitude of the various types of irregularities. It is the purpose of this subsection to present the few disturbance data gathered under this program and to indicate trends or possible associations of the disturbances with various sizes and classes of rocket engines. Published data of the type needed to accomplish this association were found to be extremely limited. It was necessary, therefore, to obtain most of the information from discussions with those engaged in the rocket engine manufacturing industry and with those engaged in engine testing at various governmental laboratories. For their assistance in supplying the data of this subsection sincere gratitude is extended to personnel of the Lockheed Propulsion Company; Rocketdyne Division of North American Aviation Inc.; Aerojet-General Corporation; The Lewis Research Center, Goddard Space Flight Center, and George C. Marshall Space Flight Center of the NASA; Thiokol Chemical Corporation; and Aro, Inc. References are given in the following paragraphs only when the material was obtained from published documents.

A short discussion of the types of thrust irregularities of interest and their areas of applicability will aid in an understanding of the data to be presented. The first irregularity which comes to mind is that of variable thrust magnitude during "steady" burning, but a cursory analysis indicates that variable thrust magnitude during the build-up and decay periods are more likely to produce significant disturbances. Actually both of these irregularities are important primarily for multi-engine missiles or stages. Single and multi-engine stages are affected, however, by drift and lateral deflections of the thrust vector which occur independently of engine motion. The fact that the individual total impulses of several engines clustered in a missile stage are very nearly the same is of little importance to the flight control analyst. To the contrary, variations in the burnout time of solid engines, resulting from slightly different burning rates, may create a control disturbance so great that thrust termination techniques are required to eliminate the problem. A realistic case analyzed for this phenomenon, resulted in an unusable fuel value of two percent.

Rocket motors used in reaction control systems are susceptible to the same types of irregularities as the main engines, except here the differences in impulse between the two motors used to produce a couple are highly significant. Variations in thrust build-up and decay time have added importance in reaction control motors because of their direct influence on the phase characteristics of the attitude control loop. The location of fixed reaction control motors relative to the vehicle's center of gravity and the alignment of their nozzles are factors which influence the reaction control system performance but are not considered here.

Main Propulsion Engines

Thrust vector drift within an engine can be attributed to unstable burning and to thrust chamber dimensional variations. Grossly unstable burning characteristics are not found in production engines but "slight" instabilities typically occur when engines are operated above their design thrust ratings (1, 2). One uprated liquid propellant engine of approximately 100,000 pound thrust was found to have an average vector drift of 0.25 degrees with a maximum drift of 0.54 degrees. These drifts were accompanied by lateral vector displacements of one-quarter to one-half inch. Vector displacements of one-quarter to one-eighth inch have been recorded in engines in the 10,000 pound class. It appears that the displacement variation decreases for smaller engines and is minute in reaction control motors. There is evidence that vector displacements are related to chamber, throat, and nozzle deformations as well as possible combustion instability influences. The more rugged construction of the solid propellant engines minimizes their vector displacement variations. Unfortunately measurements of vector drifts and vector displacements have not been made on most engines; and the number of measurements made on the engines which have been examined is not sufficient for statistical evaluation.

Some measurements taken on a number of current production, solid propellant, single chamber, multi nozzle, rocket motors indicate the occurrence of asymmetric thrust conditions between nozzles to be quite prevalent. The measured values indicate the side loadings on the motors, due to the asymmetric thrust discharge, to be as high as 0.5% of the axial thrust. This thrust vector disturbance has been attributed to the positioning errors developed by the individual nozzles when gimballed at full thrust. The causes of these position errors are nozzle thrust vector shift due to erosion and failure of the nozzles to return to assigned neutrals.

Thrust build-up of the main propulsion engines can cause significant disturbances on multi-engine upper stages. (Initial or boost stages are usually mechanically held down until the thrust in all engines has stabilized and thrust build-up disturbances to the control system are thus not produced.) Variations in thrust build-up differ for solid and liquid engines. In the liquid engine case the characteristics of the propellant

control system are most influential; and the thrust may overshoot in one engine by an amount equal to the value given in the engine specifications, while the conjugate engine's thrust may not overshoot at all. A disturbing impulse equal to the product of several percent of rated thrust times one second may result. In solid engines the primary factor affecting the thrust build-up is the initial temperature of the propellant. The sensitivity of this factor is a function of the particular propellant used, but a one percent change in the thrust build-up rate for each two degrees change in initial temperature is typical. The temperature differences between a segment exposed to the sun and one on the shaded or wind cooled side of a missile may be significant, especially if such pad conditions exist for extended periods prior to launch. The curves of Figure 32 illustrate how the thrust, its build-up, and decay are influenced by temperature in a solid engine, even though the total impulse is unaffected.

Variations in solid engine thrust decay times, as mentioned above, will usually be so great that thrust termination techniques will be required on all multi-engine stages to achieve acceptable performance. Liquid engines typically have relatively small variations of decay impulse, being eight to ten percent of the specified nominal decay impulse. Also typically, the thrust of a liquid engine decays to five percent of its initial value in one-half second, and trails off to essentially zero in an additional second or second and one-half.

An interesting anomaly to the generally predictable shut-down characteristics of the liquid propellant engines was experienced by a fully developed engine in the 10,000 pound thrust range. The anomaly occurred in the form of a residual chamber pressure surge, which occurred in most cases about 14 seconds after shut down. The residual chamber pressure lasted about 26 seconds and produced from 60 to 80 lbf-sec of impulse. This characteristic is not considered unique to this particular engine since it has been experienced occasionally by other liquid propellant engines, and quite frequently on solid propellant motors.

Variations of thrust in liquid engines during "steady" burning are usually small because of the use of propellant modulating thrust controls. The mean deviation of thrust during a firing is typically 0.08 percent. From run to run the mean deviation of average thrust is on the order of 0.35 percent. The random variation of the instantaneous difference in thrust of conjugate engines, which constitutes a control system disturbance in multi-engine applications, may be described by a power spectrum density; but such data are not known to have been measured for any engine. Examination of thrust-time curves and discussions of instrumentation characteristics and limitations, however, have permitted the generation of a crude approximation of a typical power spectrum density curve as shown in Figure 33.

The thrust of solid propellant engines is generally not controlled nor is it generally desired that the thrust be a constant. The design of the grain, together with the characteristics of the propellant, determines the nominal thrust-time relationship. Variations in the chemical

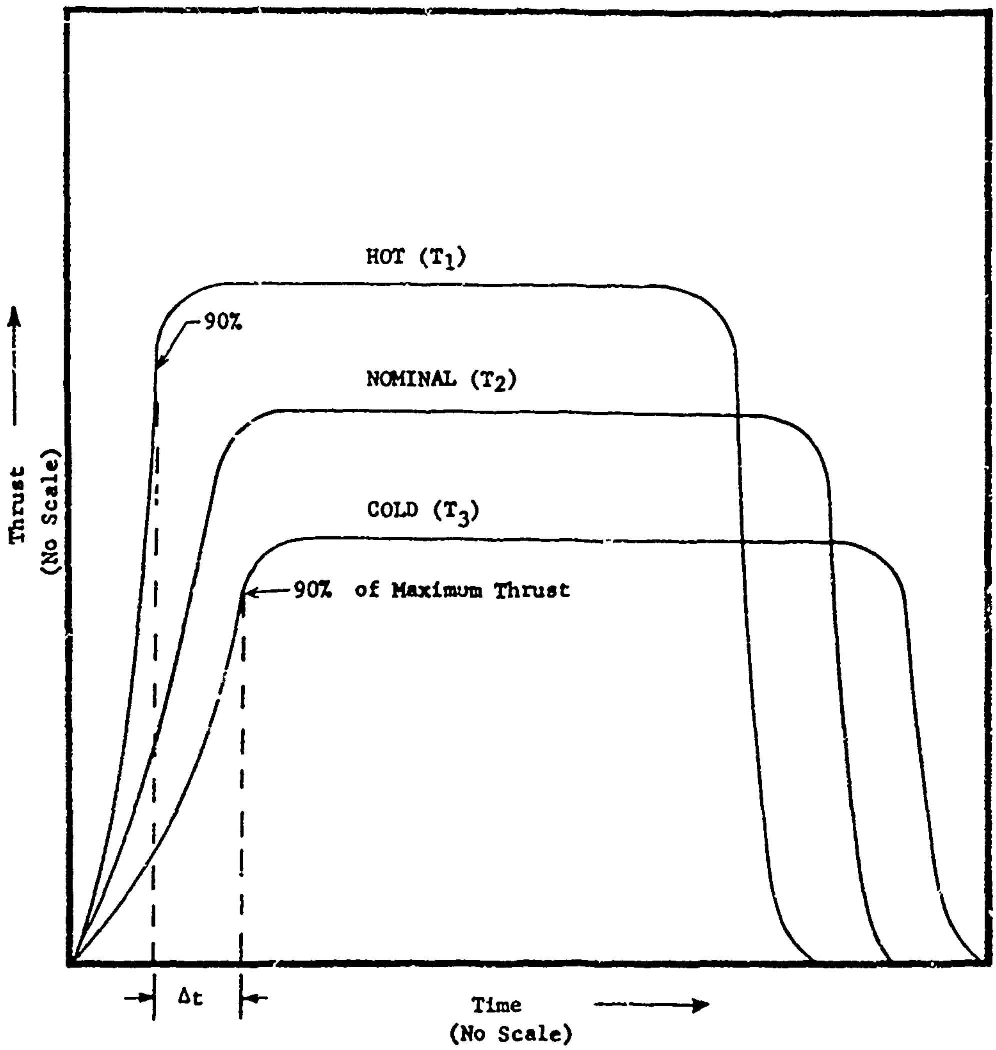


Figure 32. Thrust Characteristics for Solid Propellant Motors for Various Propellant Temperatures

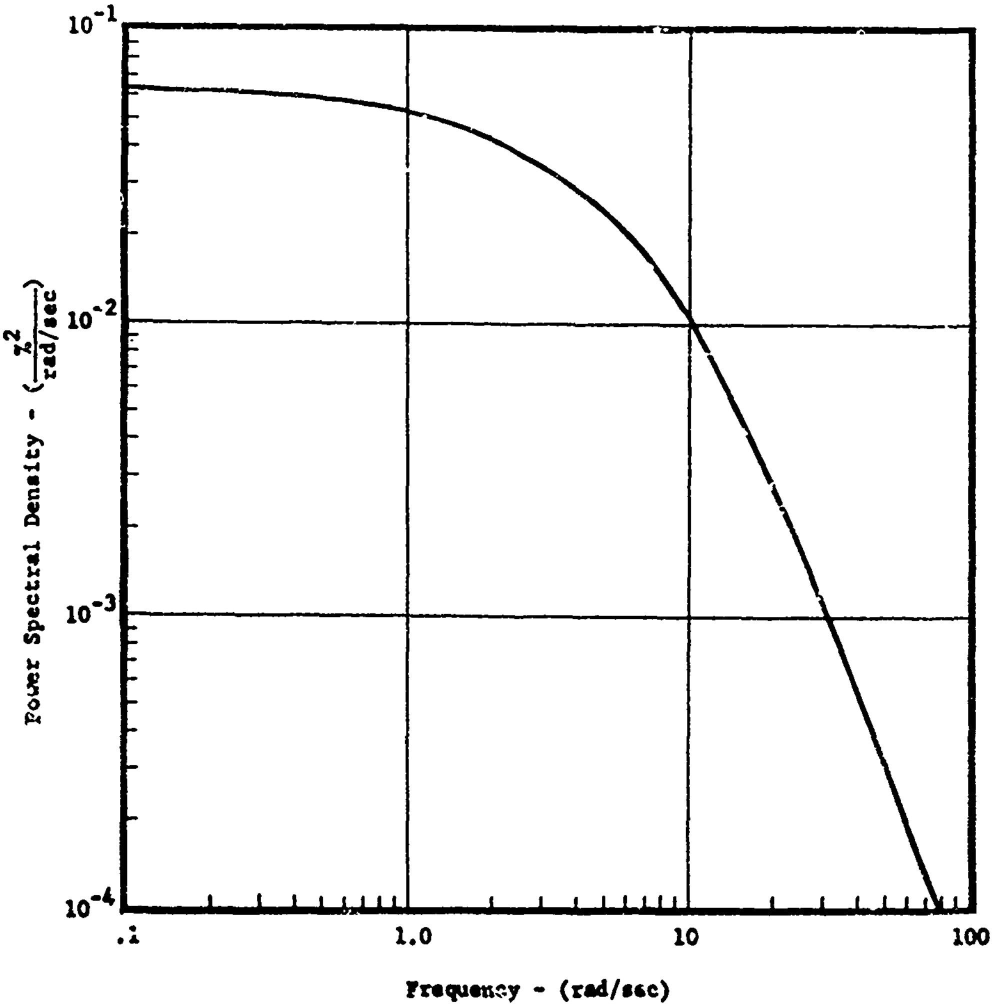


Figure 33. Thrust Percent Variation Power Spectrum

and physical properties of the grain, however, cause the thrust, during any particular firing, to deviate from the nominal curve (3). Plots of arbitrarily selected thrust-time curves for a solid propellant engine are shown in Figure 34. As can be seen in the curves, this engine is in the 3,000 pound thrust class. Larger solid engines, which are cast from a number of batches of propellant, exhibit less thrust variation from the nominal; because of the averaging of characteristics of the many batches. Variations of the performance of propellants within a batch are typically less than one percent with between-batch variations being less than one and one-half percent.

One characteristic of liquid propellant main engines, which is not related to thrust irregularities but which can produce a significant disturbance, is that of the propellant pump's angular momentum(4). As the pump accelerates it produces torques in the exact manner as a reaction wheel. During any period of time of rotation it obviously behaves as a gyroscope and when it "runs-down" at engine shut-off it again behaves as a reaction wheel. On some proposed higher pressure engines this characteristic is pronounced.

If a multi-engine stage is to be designed to operate with one engine inoperative, this factor will obviously override all other requirements for control power. Whether operating with all engines functioning or with one engine not functioning, the other disturbances discussed in this subsection must be considered, particularly those which influence the dynamic performance requirements of the flight control system.

## Control Motors

Control motors consist of ullage and retro rockets, used for stage separation and payload deceleration, and reaction control motors which provide control of attitude and vernier translation.

Irregularities of ullage and retro rockets are generally similar to those associated with the main propulsion engines, except that thrust vector drift and vector displacements are lower in magnitude and the variations in total impulse and average thrust level variations of solid propellant rockets are greater than the larger main propulsion versions. The differences are directly related to the smaller sizes of the control motors. It is frequently impractical to design for a misfire of an ullage or retro rocket used for stage separation simply from consideration of separation clearances. Variations in thrust or impulse of these motors, however, may be tolerable from a clearance standpoint yet introduce tumble rates of the upper stage which are highly significant as disturbances to the upper stage flight control system. No statistical data were obtained on disturbances in this particular area during the study.

Of the various types of reaction control motors the cold gas type is the most widely used at present. At a constant temperature and with a

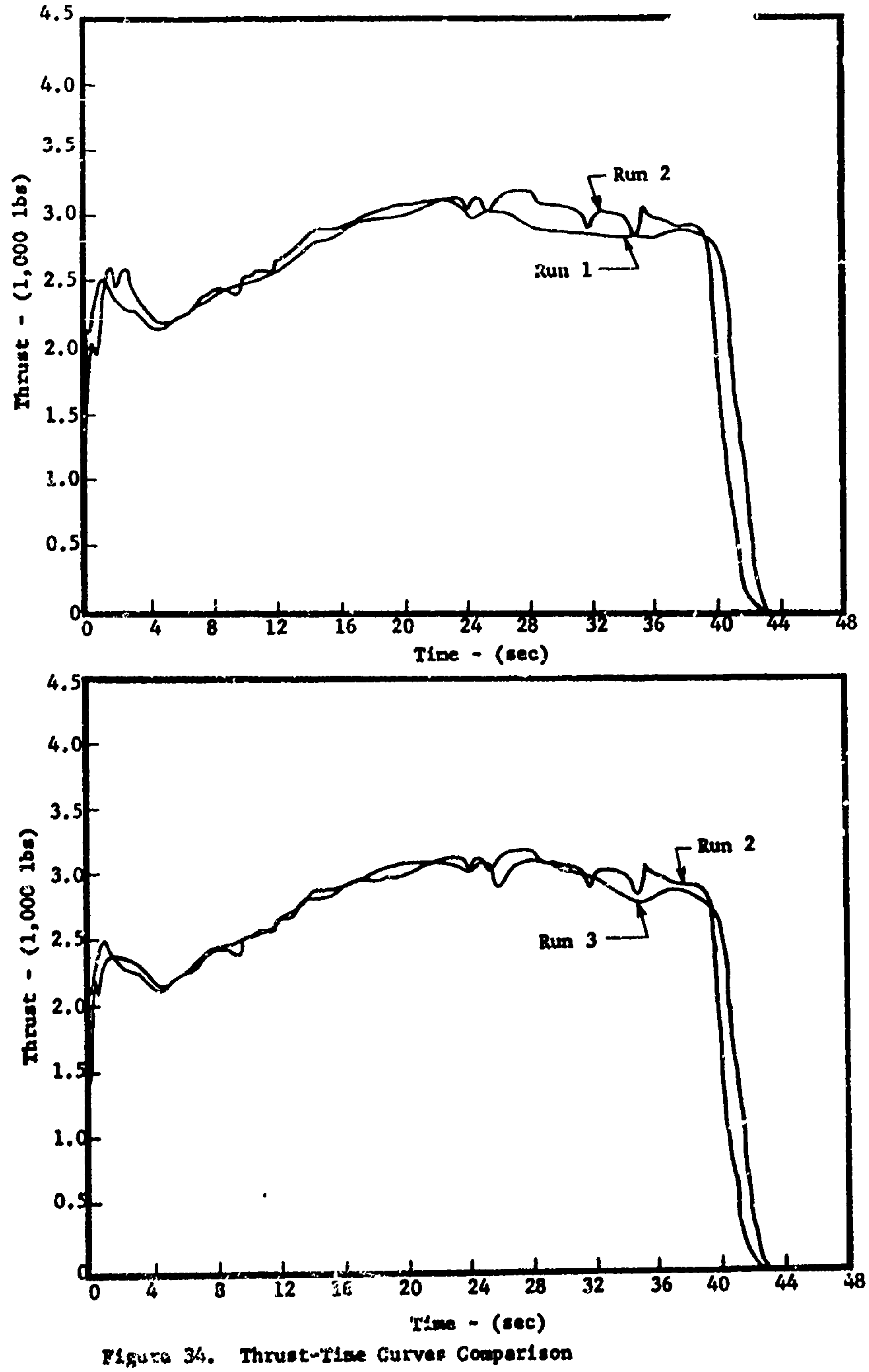


Figure 34. Thrust-Time Curves Comparison

constant supply pressure, the variations in delay time, thrust rise time, thrust level, and total impulse do not vary more than one percent. Manufacturing tolerances are such, however, that motor-to-motor variations in the impulse, in some widely used models when subjected to the same electrical signal, are as much as plus and minus ten percent.

Mono-propellant reaction control motors using hydrogen peroxide are the most widely used propellant type (5, 6). Numerous studies have been made on the characteristics of particular motors and of the effe t of certain design parameters. The main variable associated with hydrogen peroxide motors is the delay time prior to thrust build-up (7, 8, 9). If the catalytic bed, usually downstream of the control valve and adjacent to the nozzle, is at a temperature below about 40 degrees the hydrogen peroxide will not decompose. As the temperature is increased the time delay before thrust build-up will decrease from several tenths of a second to a minimum of approximately 50 milliseconds when the temperature is above 100 degrees. Thrust decay time is a function of the volume between the nozzle and the control valve, but will typically be a tenth of a second. Once the catalytic bed temperature has been raised to a value above 1,000 degrees, the reproducibility of characteristics for the hydrogen peroxide motor is comparable to that of cold gas motor.

Bipropellant reaction control motors have been introduced in recent years (10) but no field use of such motors is known. The obvious advantage of bipropellant motors is the associated high specific impulse. A second advantage is the small value of delay and thrust build-up times which can be achieved. The data available indicate that delay times of six to twenty milliseconds and thrust build-up times in the range from one quarter to ten milliseconds are typical. The fact that two propellants have to be metered, however, makes the likelihood of long-time thrust and impulse repeatability questionable. A ripple of several percent at a frequency in excess of 100 cycles per second is seen during the "steady" thrust of this type motor, but lower frequency components are not evident.

One characteristic of the bipropellant motor, important when it is used for short pulses, is the relatively large change in its thrust build-up transient with decreasing ambient pressure. A motor which exhibits essentially zero overshoot at sea level has a hundred percent thrust overshoot at altitude followed by a momentary decrease to near zero thrust before steady state is achieved.

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ACOUSTICAL VIBRATION

Acoustical vibration is caused by a vehicle's propulsion system, aerodynamic effects, and accessory equipment. The degree to which these vibrations might be considered control system disturbances is somewhat obscure. It is possible that the coupling of an airborne sound pressure and a control surface would be significant in certain cases. Production of false signals in control system sensors is also a possible effect of acoustical vibrations. Their major effect on structure is not within the scope of this report.

Acoustical vibration levels are greatly influenced by mountings, structure, and skins, the designs of which in turn are almost limitless. For this reason data are simply presented in the form of general magnitudes and frequencies that have been recorded from past experience with both flight vehicles and static test stands. It is intended that the information will be useful in providing the analyst with an insight as to the approximate magnitudes of the parameters involved.

Of the various sources of acoustical disturbances, by far the most important are the vehicle's engines. In aircraft applications the effects of acoustics are relatively insignificant when compared to the other disturbances seen by the control system. The problem is much more significant for rocket powered vehicles; therefore, the major effort of this section will be concentrated on rocket motor acoustics. In missile applications the sound level is magnified by the fact that maximum q (occurrence of maximum aerodynamic noise) conditions are usually transversed while the engines are producing maximum output. Measurements have indicated that the aerodynamic noise pressures increase approximately as the dynamic pressure increases and may vary according to the external shape of the vehicle, highest noise levels being associated with conditions of flow separation. There is also a trend for the aerodynamic noise spectra to peak at higher frequencies as the flight Mach number increases.

Although some analytical studies have been made of the noise environment of ground-launched, rocket-powered vehicles (1, 2), few measured data are available for large vehicles. Recent flight tests of three rocket-powered vehicles in connection with Project Mercury have, however, provided some data of this type for a range of operating conditions. Some of these data are presented from Reference 3 and are compared, where possible, with results from other studies. An attempt is also made to generalize these data for use in predicting the noise environments of future vehicles. The three vehicles used for the Project Mercury test were in the below 75,000 pound, 75,000 to 200,000 pounds, and above 200,000 pound thrust ranges. The external geometries along with the Mach number and free stream dynamic-pressure ranges for the vehicles were also quite different. The flight data were recorded with the aid of onboard tape recorders which were recovered after the flights. Data relating to the external noise environment at lift off for the entire vehicle used in the tests are given in Figure 35. Sound pressure levels (SPL) in decibels (reference level, 0.0002

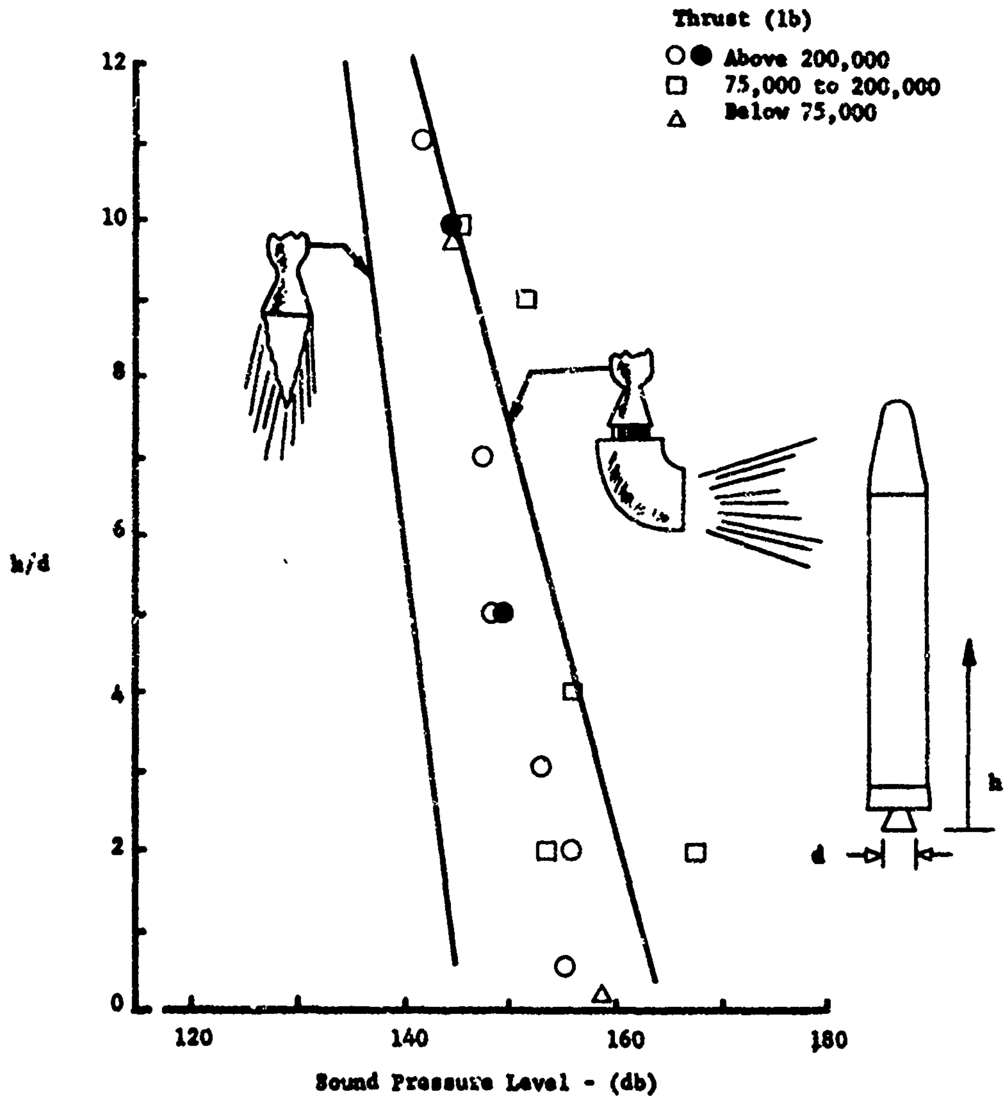



Figure 35. External Sound Pressure Levels at Lift-Off.

dyne/cm$^2$) are plotted for various relative distances along the missile, h/d; where h is the distance measured from the nozzle exit plane toward the nose of the vehicle, and d is the equivalent nozzle diameter. For a multiple-nozzle arrangement, d is assumed to be the diameter of a circular nozzle equivalent in area to the sum of actual nozzle areas. As a matter of interest, the thrust of large booster engines per unit nozzle exit area is nearly a constant. Thus, this quantity d is essentially proportional to the square root of the total thrust of the vehicle.

The location of the two lines (Figure 35) was based on experimental results from model supersonic jets and small rocket engines. The line on the left represents the estimated SPL along the outside of the vehicle for the case where the rocket-engine exhaust exists straight down and is not deflected (4, 5). Such a condition as this might exist when the vehicle is at a high enough altitude to be outside of the ground effects but still at some low flight velocity. It has been found according to Reference 3 that a turning of the exhaust stream results also in a turning of a noise field by about the same amount. On this basis the line on the right has been drawn to indicate the maximum SPL that would result from a 90° deflection of the exhaust stream. Plotted on Figure 35 also are several datum points obtained for rocket engines of various thrust ratings. It will be noted that the data for large rocket engines fall generally between the extreme values of the lines. The only exceptions are the datum points on the extreme right. These apply to an engine having noise spectra which contain large discrete peaks probably resulting from rough burning. It can be seen that the SPL increase in general for stations closer to the nozzle exit, that is, for smaller values of h/d. Although this is a rather unsophisticated approach to predicting the SPL along the surface of the vehicle, the fact that data correlated well for a wide range of jet sizes gives confidence that it will be useful for larger-thrust vehicles.

In addition to the overall SPL, it is of interest to know the internal and external sound levels and spectra at various stations along the vehicle. As an example, data are given in Reference 3 for an operational vehicle of the over 200,000 pound thrust liquid engine class, which show noise spectra for both external and internal measuring stations. The data as presented in Figure 36 for the nose cone area show pressure levels for various octave bands in cps. The spectra measured at other external stations along the vehicle were of larger levels, and progressed in magnitude with decreasing distance to the engines; but did not differ appreciably in shape from the external spectra shown in Figure 36. A procedure for correlating rocket engine sound spectra levels in the region surrounding the vehicle is given in Reference 6.

It has been noted that the internal noise pressures increase as the dynamic pressure increases; but for constant q values, lower sound pressure levels are associated with higher Mach numbers. In order to illustrate this, internal noise spectra data for two different Mach numbers are shown in Figure 37 for a vehicle of the over 200,000 pound thrust

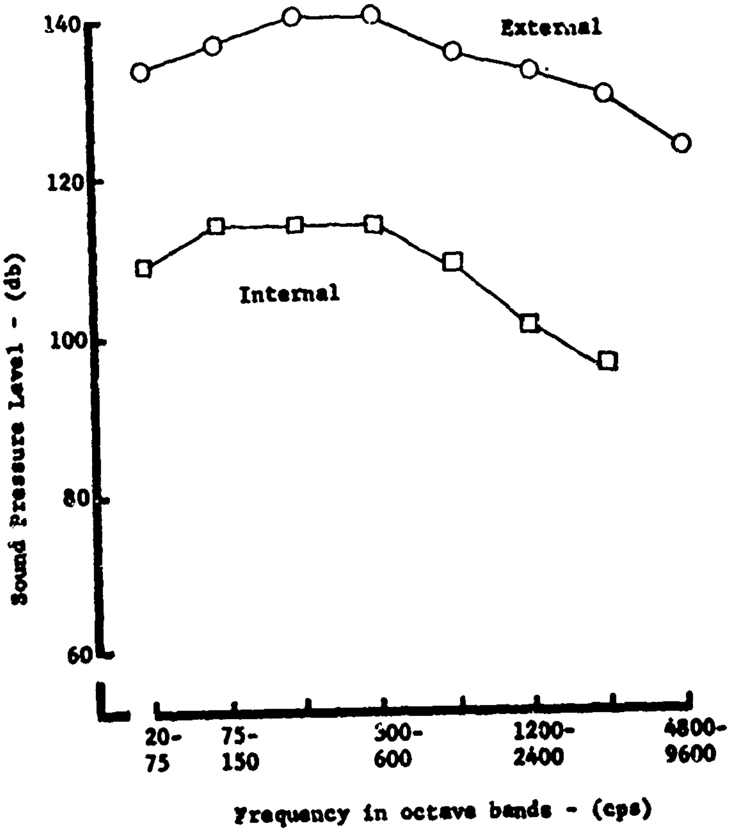



Figure 36. Nose Cone Noise from Rocket Engines

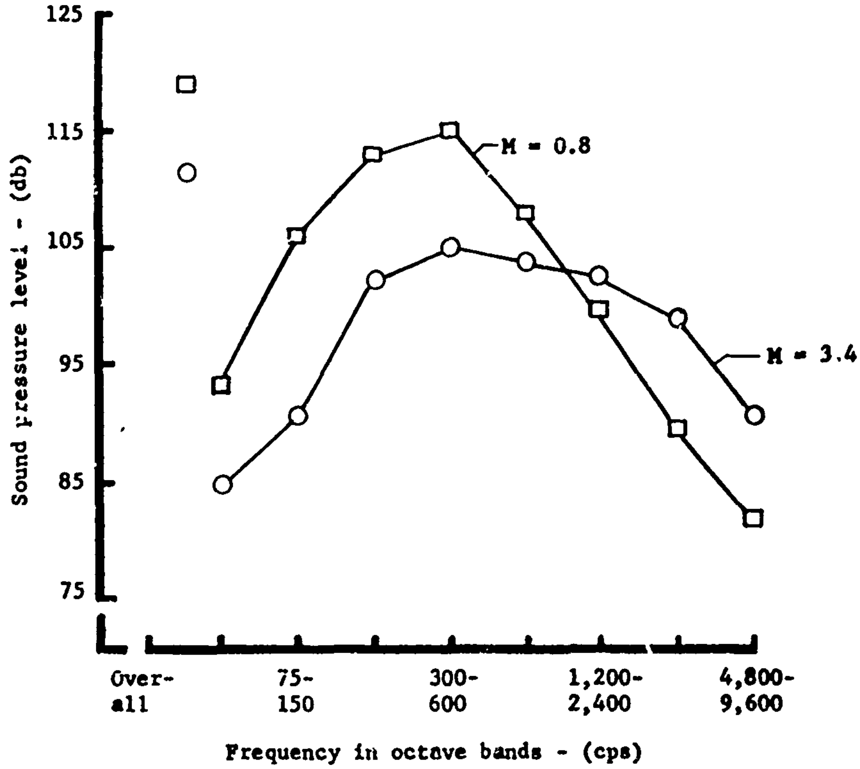



Figure 37. Internal Sound Spectra at Constant q for Various Mach Numbers

range. In this figure, taken from Reference 3, SPL is plotted for various octave bands for both subsonic and supersonic Mach numbers. It appears from the figure that the spectrum at the higher Mach number peaks at a higher frequency. This shift of the peak of the spectrum toward higher frequencies is believed to result in a greater transmission loss through the structure (7) and thus to lower inside sound pressure levels.

Two other studies (12, 13) on similar vehicles of the 150,000 pound thrust range, recorded SPL of approximately 137 db during launch and transonic flight. Similar measurements recorded during captive firings were about 150 db. These readings were taken externally at the nose cone areas about 75 feet from the engines. The frequency spectra were typical broad band noise with the majority of the sound energy concentrated in the frequency band of 60 to 1,600 cps. The data from these studies agree well with the data from Reference 3. Examination of the in-flight data on SPL at the same forward locations for these three latter studies showed two typical peaks of acoustic disturbance, one at lift-off and the second just prior to maximum q. This second peak happens to coincide well with transonic occurrence, and indicates the large effect of aerodynamics on the SPL's.

Another study (8) presents the values of acoustical noise surrounding a statically fired vehicle using two 33,000 pound thrust solid propellant boosters and a 10,000 pound thrust turbojet sustainer. The recorded values are presented in Figure 38 at various vehicle stations. The highest intensity external noise is located at fuselage station 706 which is the approximate location of the booster engines' exhaust nozzles and the sustainer engine inlet. The intensity of 186.5 db recorded at this location is considered as a moderately intense sound level, and would be capable of causing significant disturbances to nearby equipment, depending on the frequencies of the noise and the frequency response of the equipment. The frequencies recorded at station 700 for the external noise levels are shown in Figure 39. From the figure it appears that the greatest portion of the higher-intensity sound falls in the 60 to 6,000 cps frequency, although lower and higher frequencies are present at significant pressure levels.

The internal sound levels are also presented in Figure 38 and show the most intense levels to occur at fuselage stations 561 and 700 with pressure levels of 163 and 162 db respectively. Station 561 is in the center of an instrument bay, and therefore it would be of prime importance to determine the effects, if any, of the sound pressure upon equipment at this location. The frequencies of the internal sound pressures for station 561 are presented in Figure 40, which shows the bulk of the high-intensity noise falling between 60 and 600 cps. The internal noise also has moderate intensity sound at lower and higher frequencies.

Vibration levels measured in this general vicinity on the vehicle structure by means of accelerometers showed the mechanical vibrations of the structure to be on the order 40 to 50 g's with a frequency of 400 to 600 cps at the maximum g levels. Lower frequency vibration levels of less than 40 cps showed magnitudes of 4 to 10 g's. The

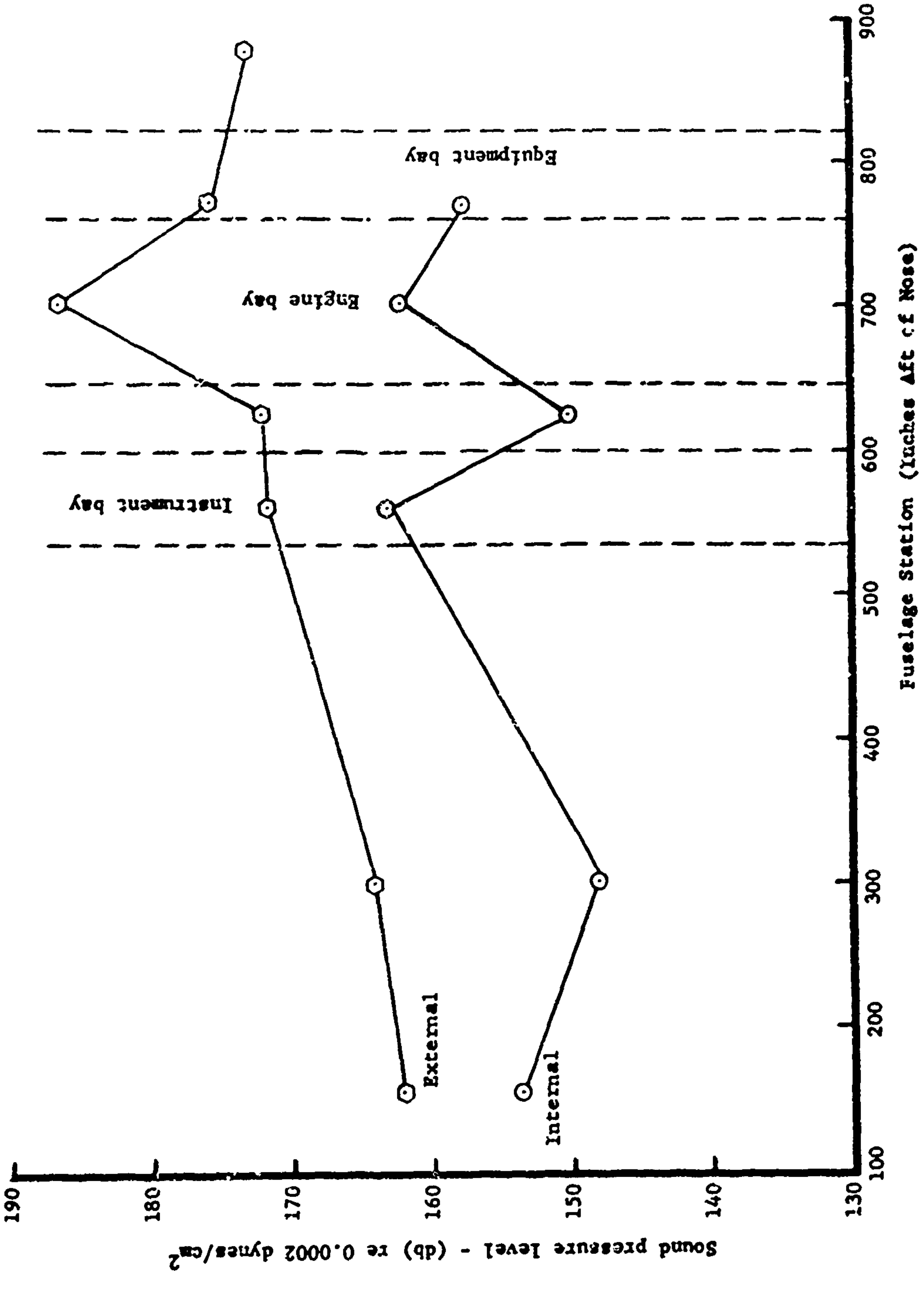



Figure 38. Overall Sound Pressure Level vs Fuselage Station for Vehicle of Reference 8.

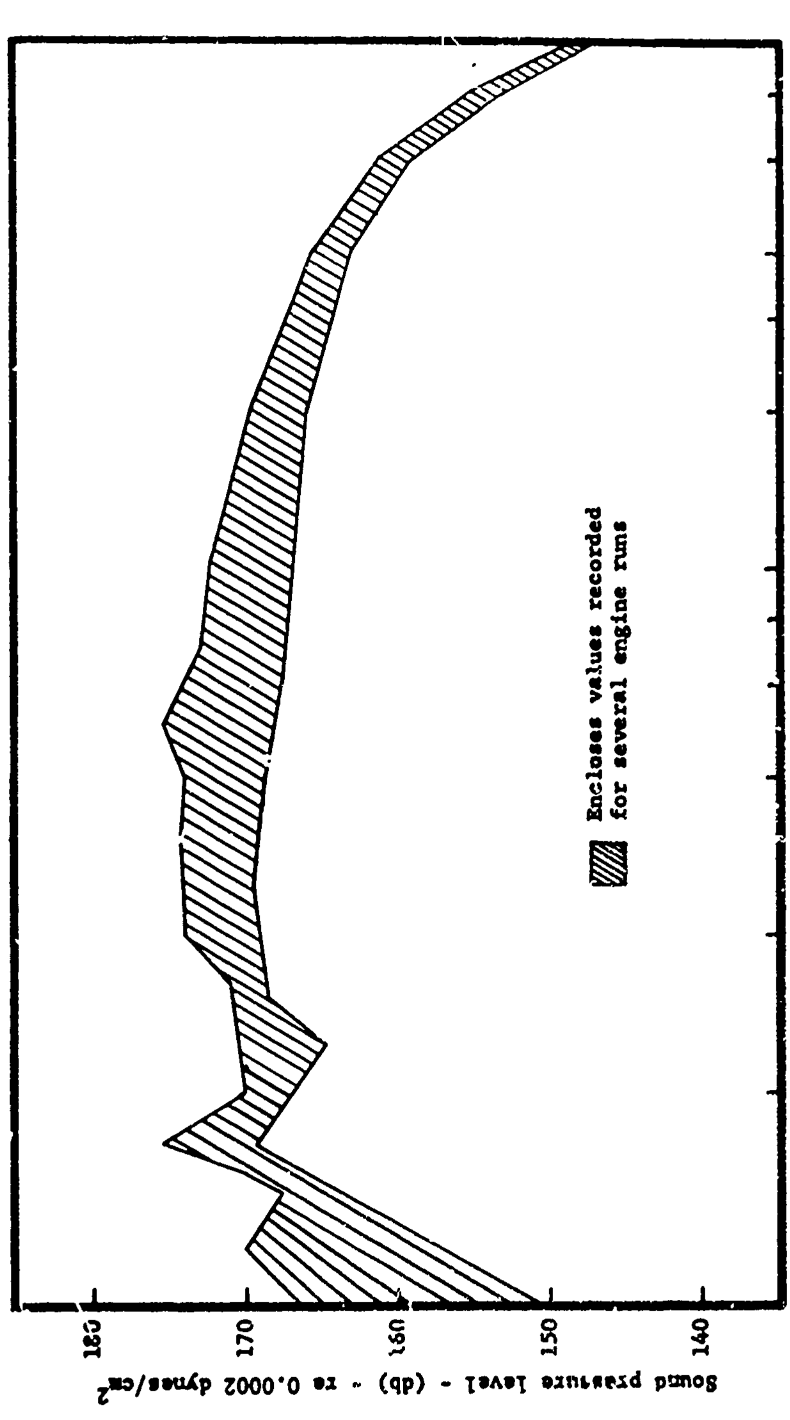



Figure 39. External Sound Pressure Levels at Fus. Sta. 700 vs Frequency for Vehicle of Reference 8.

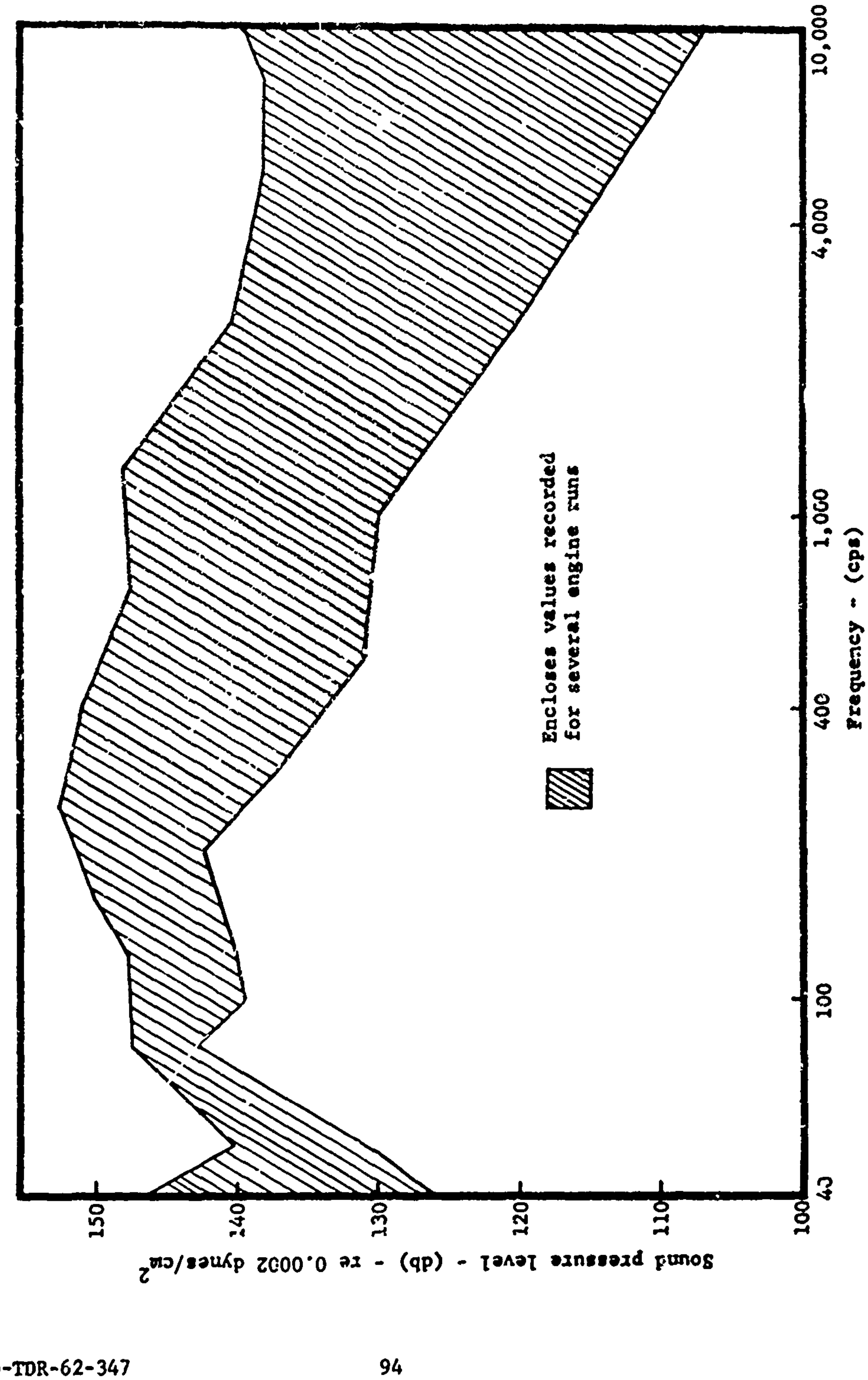



Figure 40. Internal Sound Pressure Levels at Fus. Sta. 561 vs Frequency for Vehicle of Reference 8.

magnitudes of these lower frequency vibrations seem to agree well with values from Reference 10 for similar small solid propellant motors, but are quite high when compared to values at similar low frequencies for medium size liquid propellant motors in Reference 13. This may be attributed to the fact that solid motors are usually much more rigidly mounted than liquid propellant motors and consequently transmit combustion vibration more readily. The high frequency vibrations have primary effect in the analysis of fatigue; but, when consideration is given to the magnitudes, they may be of some influence on the control system. The range of data in Figures 39 and 40 is particularly worthy of note, with a spread on the order of 25 db seen for some frequencies in Figure 40. Variation of such magnitudes from one firing to the next of a given vehicle is not uncommon for the small to medium size missiles.

Comparison Levels

For noise analysis of engine applications, where no actual noise levels have been recorded, it might be useful to know the noise levels recorded from similar engines. Knowledge of similar engine noise levels may enable a close approximation to be made on the basis of a similarity comparison. Reference 9 presents SPL measured for fourteen different engines in the 1,000 to 130,000 pound thrust range. A summary of the average near field SPL from the various standard engine sizes measured at several positions surrounding the engines is presented in Figure 41a. As a comparison the overall sound pressure levels at 250 feet at various angles with respect to the thrust axis are shown in Figure 41b. For noise levels at distances under 300 feet the inverse square method of determination gives reasonably accurate results. The locations of the various sound pickups used in acquiring the data in Reference 9 are shown in Figure 42. Plots of the magnitudes of sound pressure in the lowest recorded range of 37.5 to 75 cps for these locations are shown in Figure 43. To compare the relative importance of the higher octave bands, Figure 44 presents the acoustic power level spectra associated with the various engine sizes. A detailed analysis of SPL's for higher frequencies, as well as many other parameters of acoustic phenomena for the various engines, are contained in Reference 9.

A significant fact that must be remembered when using acoustical data acquired from statically fired engines is the variance in structural response between a static engine mount and an actual payload vehicle. The ideal approach to estimating flight vibration characteristics from static test data is to use an acoustic isolator and soft mounting system with the motor attached to its payload. Vibration measurements on the payload should then be nearly identical with the actual motor produced flight vibration. This ideal condition cannot be attained as often as the analyst might desire, because each motor will usually propel several dynamically different payloads or estimates of the vibration environment are needed early in the design test period of the motor and payload vehicle when elaborate static tests are not possible. For these reasons expediency often dictates a less than ideal condition

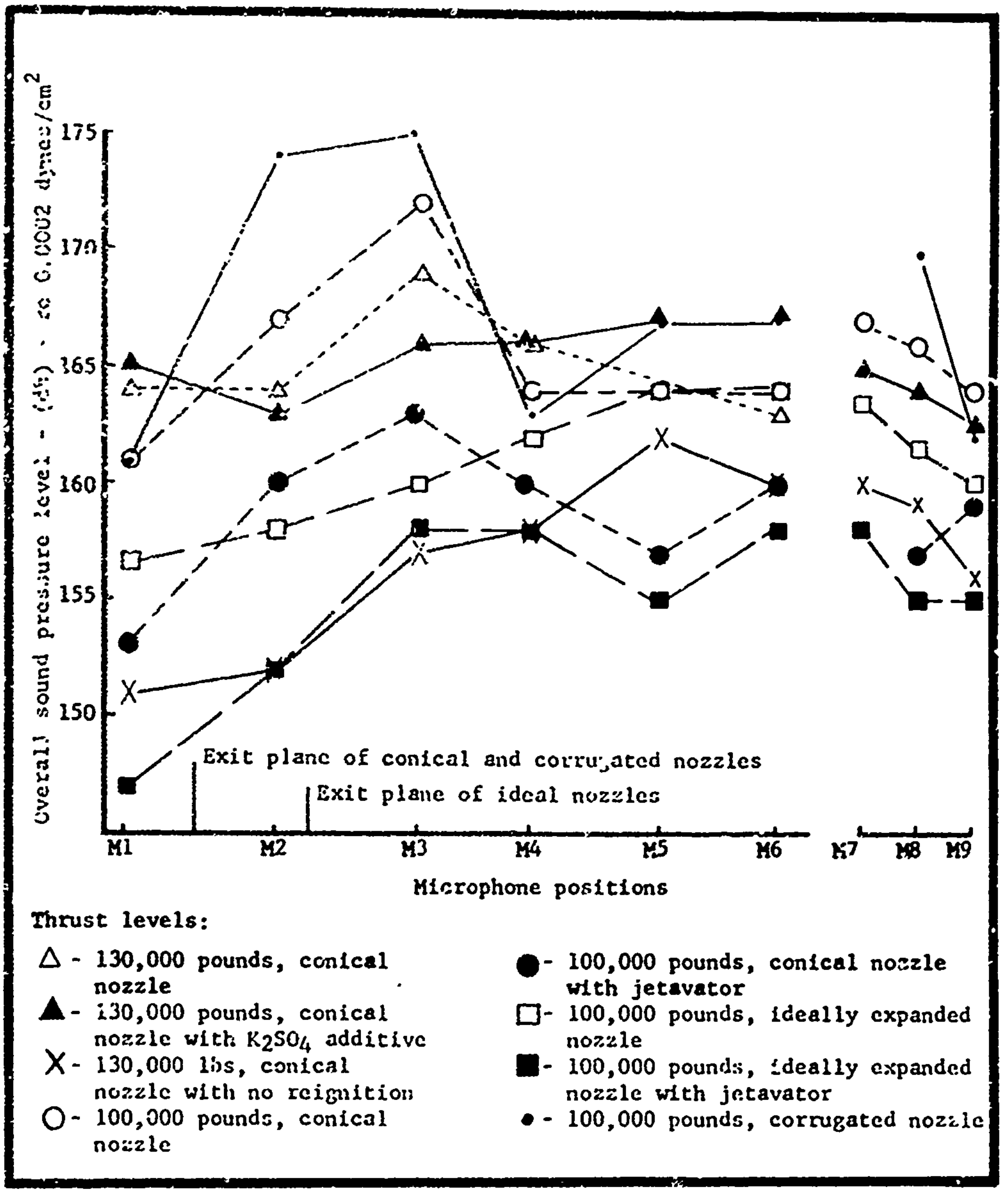
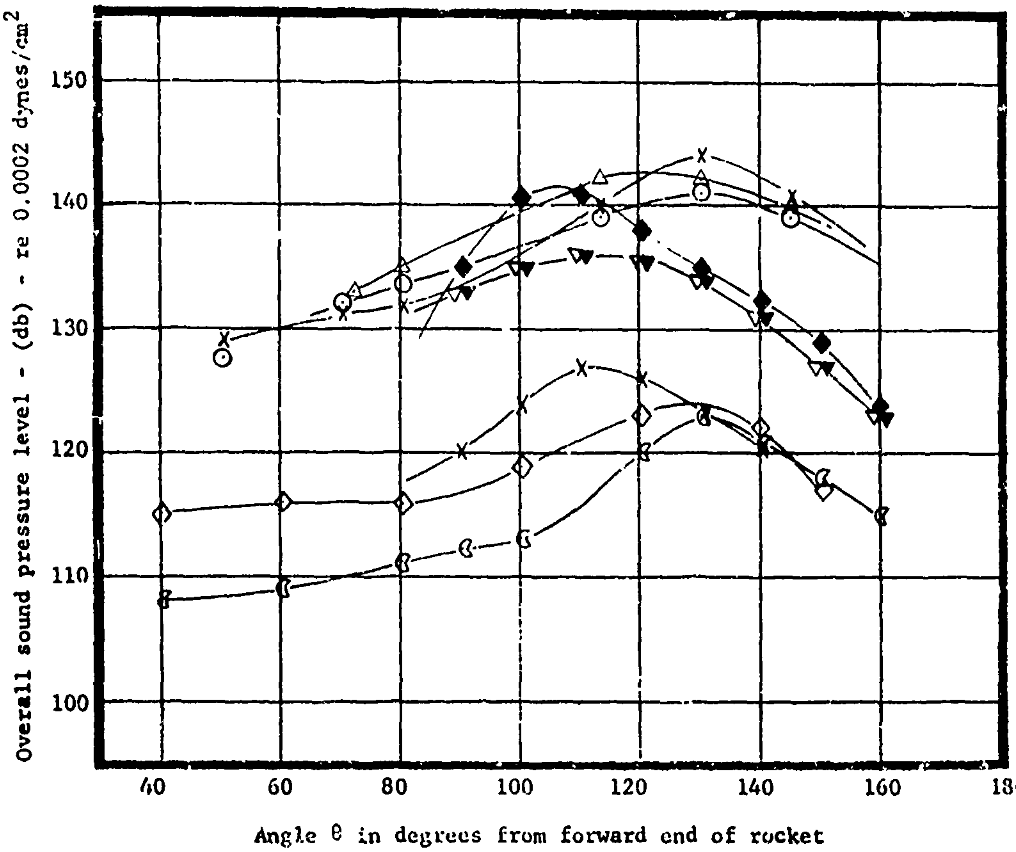



Figure 41a. Average Overall Near Field Sound Pressure Levels.




Thrust levels:

△ - 130,000 pounds

X - 130,000 pounds

○ - 100,000 pounds

◆ - 78,000 pounds

▲ - 48,400 pounds

▽ - 34,000 pounds

+ - 10,000 pounds

◇ - 5,000 pounds

ϱ - 1,000 pounds

Figure 41b. Overall Sound Pressure Levels at 250 feet for Various Thrust Level Engines.

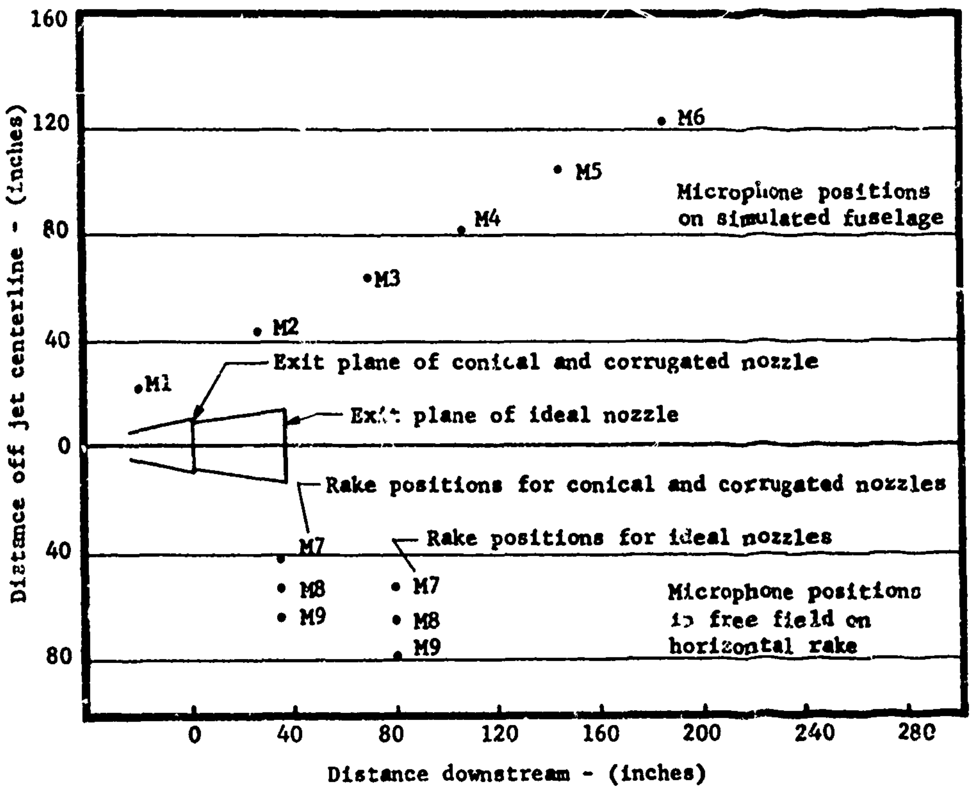
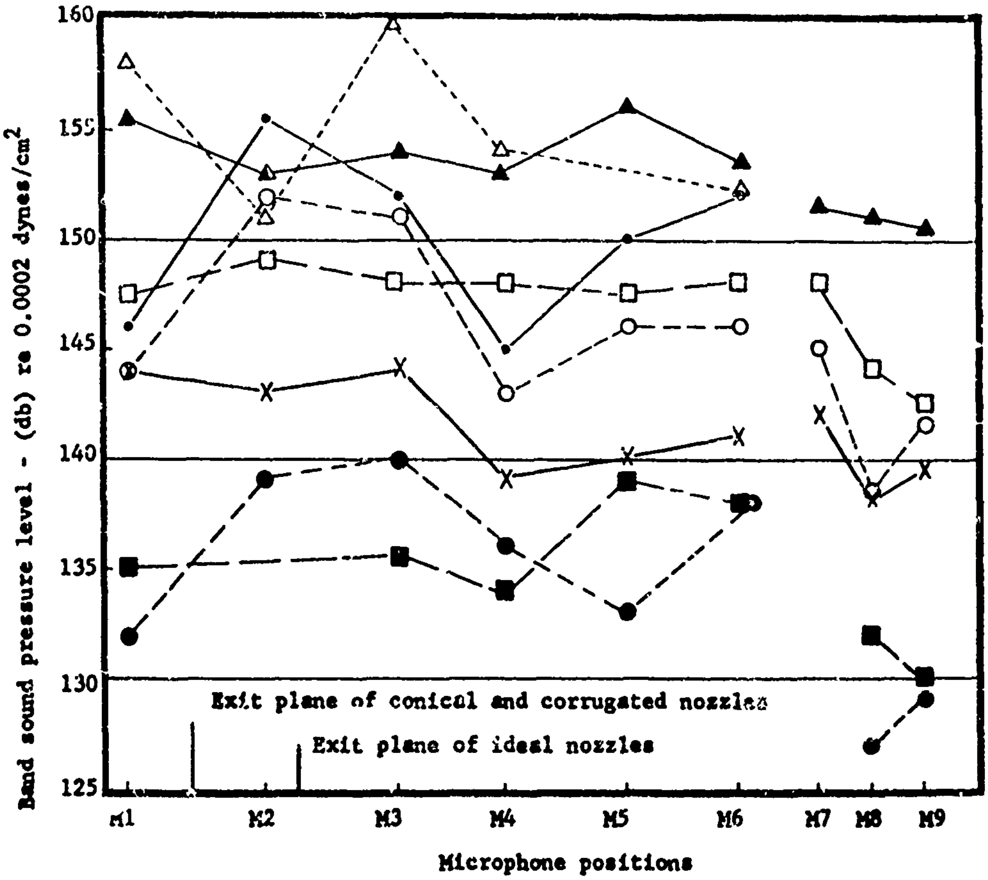


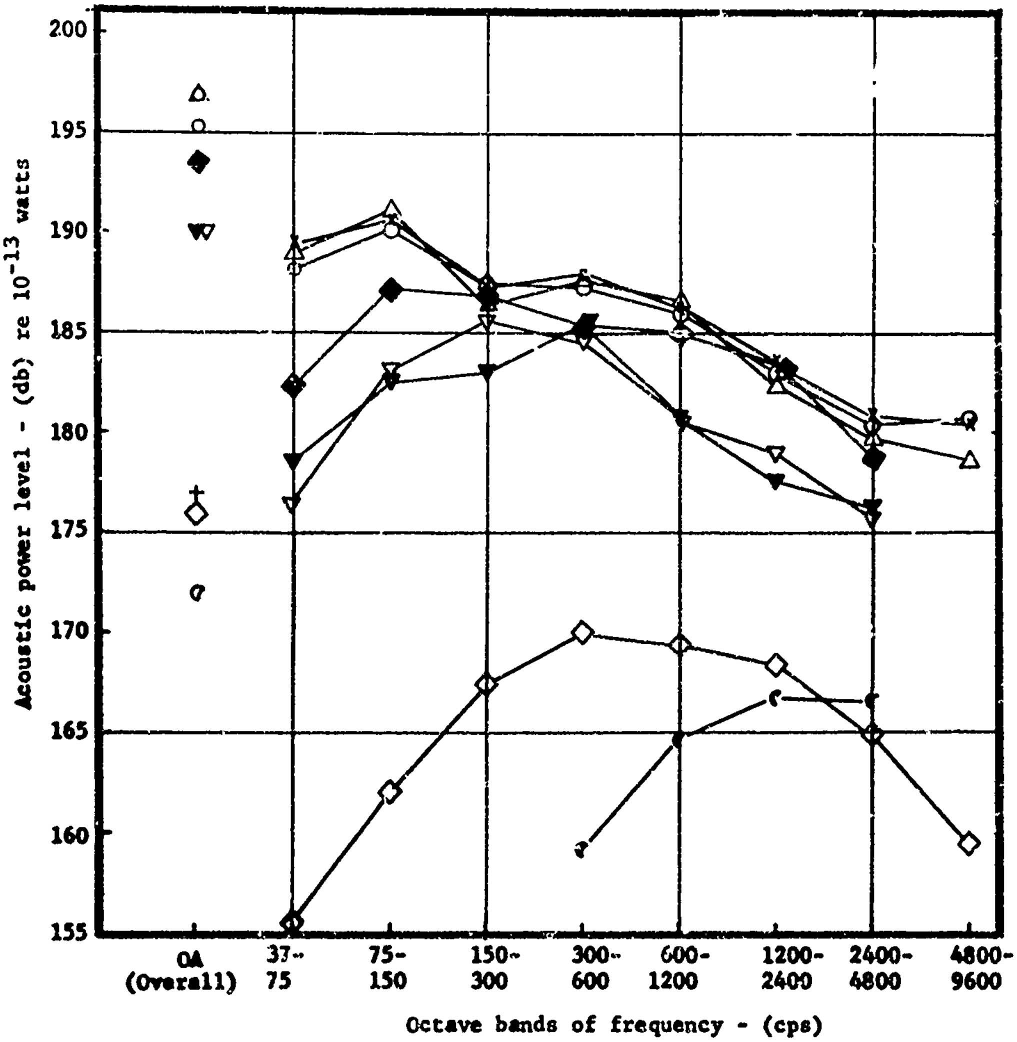

Figure 42. Near Field Microphone Locations




Thrust levels:

△ - 130,000 pounds, conical nozzle
▲ - 130,000 pounds, conical nozzle with $K_2SO_4$ additive
X - 130,000 pounds, conical nozzle no reignition
○ - 100,000 pounds, conical nozzle with jetavator
● - 100,000 pounds, ideally expanded nozzle
■ - 100,000 pounds, ideally expanded nozzle with jetavator
• - 100,000 pounds, corrugated nozzle

Figure 43. Average Near Field Band Sound Pressure Levels in the 37.5-75 cps Frequency Range




Thrust levels:

△ - 130,000 pounds, conical nozzle
X - 130,000 pounds, conical nozzle no reignition
O - 100,000 pounds, conical nozzle
◆ - 78,000 pounds, conical nozzle
▼ - 48,400 pounds, conical nozzle
▽ - 34,000 pounds, conical nozzle
◇ - 5,000 pounds, approximate conical nozzle
☾ - 1,000 pounds, conical nozzle

Figure 44. Acoustic Power Level Spectra

for vibration instrumentation; specifically, use of actual payloads, acoustic isolators, or soft test stands may not be practical. Further, the accelerometers may have to be attached directly to the motor case rather than to structure representing a payload. A detailed approach to the problems of proper simulation of acoustical vibration data for use in performance analysis along with some specific test results supporting the theories involved is contained in Reference 10.

## Exhaust Deflectors

The specific arrangement used for ground launch must be considered since different designs of launch pads, flame deflectors, and launch positions can influence the sound pressure level produced in the immediate vicinity of the noise source. The particular distribution of SPL along any given missile structure, for example, is intimately related to the physical geometry of that particular structure and its relationship to the ground support equipment and other adjacent reflective or absorptive surfaces. Furthermore, for accurate interpretation of the acoustical disturbances, a knowledge of the time and spatial correlation of the sound pressures is required along the particular structural elements of equipment exposed to the given sound field. Unfortunately there is very little of this type data available. One study of sound effects of this nature (11) presents a series of tests conducted on several deflector and flame bucket designs to determine the changes and comparisons of near field acoustic disturbances associated with the various designs. The tests showed that the general result of deflecting the exhaust blast was an increase in the near field SPL. These increases occurred with all deflectors and usually occurred in all frequency bands. This can be explained by the fact that in most cases the source, the flow itself, was usually brought physically closer or at least reoriented to the near field positions by the deflecting actions. The percentages of SPL increase were as high as 10% in some cases, which for high noise level engines can be most significant. Further details of the various noise redistributions associated with the different deflector designs can be acquired from Reference 11.

As shown in the previous paragraphs the data on actual acoustic disturbances are of a scattered nature. The information available has been gathered for fatigue analysis, human environment, and various other reasons; and is of value in control system analysis only when used as a guide to the possible existence of acoustical levels that can be of consequence.

For the determination of engine sound level data for vacuum operating vehicles, the data should be taken in an acoustically insulated enclosure. If acoustic isolation is not used, the test results will show vibration levels must higher than will be found in vacuum flight; the results can then only serve to place a conservative top limit on the vibration levels. If the payload is not used or simulated, or if

a soft test stand is not used, the system dynamic characteristics (determined analytically or experimentally) may be used to make approximate corrections to the measured frequency data; but experience to date indicates corrections of amplitudes are not reliable. If vibration measurements are made on the motor case the low-frequency data may be corrected by dynamic analysis, but any correction of the higher-frequency data may, however, be used to estimate the maximum level.

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MAGNETIC FIELDS

For extra-terrestial vehicles, disturbance torques may be produced by the interaction of induced or established magnetic fields within the vehicle with the magnetic field of the earth. The same interaction incidentally can be used for attitude control or despinning. In the near zero aerodynamic forces of the orbital environment, relatively small forces such as those produced by the magnetic fields of electrical devices can produce torques that will rotate the vehicle. The magnitude of the torque is of course a function of the vehicle's altitude (since the intensity of the earth's magnetic field varies as the cube of the distance from the earth), longitude, latitude, moment arm, and field strength of the torquing magnets. In all probability secondary torquing effects from equipment will not be of particular significance in attitude stabilization of satellite vehicles since judicious shielding and de-perming can reduce any effective internal magnetic fields to negligible levels. Of greater importance is the satellite rotational decay resulting from eddy currents that are induced in the satellite by its rotation in the earth's magnetic field (1).

The source of the earth's main magnetic field lies predominant within the earth with approximately 1% contribution from sources outside the earth. The field at the surface of the earth resembles that produced by a dipole or short bar magnet located at the earth's center. There are significant departures from the simple dipole field which are referred to as anomalies. The large or regional anomalies which affect areas of thousands of square miles are attributed to irregularities in the earth's internal current system. It is observed that these anomalies are moving very slowly westward, indicating that the rates of rotation of the core and the crust of the earth are different. Anomalies of lesser magnitude are referred to as "local" or "surface" anomalies and are caused primarily by deposits of ferromagnetic materials within the earth's crust.

In the case of a satellite which must maintain directional alignment with respect to the earth, it must have a rate of spin equal in magnitude to its orbital rate. Since the vehicle is rotating in the earth's magnetic field there will be induced eddy currents which produce an upsetting torque. This applies to weather satellites such as the Tiros or any vehicle that must maintain an alignment in relationship to the surface of the earth. The Tiros I exhibited an angular motion of three to five degrees per day which was primarily attributable to magnetic effects. Where eddy currents do constitute a primary source of undesirable spin decay, the orbital relationship to the geomagnetic field is naturally suitable for use as an attitude control torquing source in conjunction with a system of properly oriented permanent or electromagnets. References 2 and 3 present analyses and proposed solutions of the decay problem encountered on Tiros I Meteorological Satellite.

From Reference 1, the following equations define the spin decay that an orbiting, spherical, conducting vehicle will incur for a small increment of time:

$$\omega_T = \omega_{T_o} \epsilon^{-Ct}$$

Where $\omega_T$ = angular velocity after time (t) (rad/sec)

$\omega_{To}$ = initial angular velocity perpendicular to the (rad/sec) flux lines of the magnetic field.

and,

$$C = \frac{2\pi \ \mu_o^2 \ F^2 \ a^4 \ h}{3 \ R \ J_M}$$

where $\mu_o$ = permeability of vacuum

$F$ = magnetic field intensity (oersteds)

$a$ = radius of spherical shell (m)

$h$ = shell thickness (m)

$R$ = specific bulk resistivity of the shell material

($R = 2.8 \times 10^{-8}$ ohm-m for aluminum)

$J_M$ = polar moment of inertia ($K_g/_m 2$)

$8/_{15} \ a^5 \ \rho \ \pi$ for a sphere with uniform density

distribution with $\rho$ = mean density.

The above expressions were evolved from the basic expression by Smythe (4) which gives the magnitude of the retarding torque for a spherical shell as:

$$M_T \approx \frac{6\pi \ \mu_o \ F^2 \ R \ \omega_T \ a^4 \ h}{9 \ R^2 + \mu_o^2 \ a^2 \ \omega_T^2 \ h^2}$$

## Field Analysis

Spherical harmonic analysis, based on all observations of the field vectors made over the earth's surface, yields a representation of the earth's magnetic field in the form of a dipole at the center of the earth whose field gives a good fit to the actual irregular field. The axis of the dipole gives the geomagnetic poles at 79°N, 290°E, and 79°S, 110°E. The moment is approximately $8 \times 10^{25}$ CGS units. It should be noted that these geomagnetic poles are not the same as the "dip" poles which are indicated as the magnetic poles on most maps. The dip poles are the points where the magnetic field is vertical and are located at 73°N, 262°E and 68°S, 145°E.

The spherical harmonic analysis yields an expression in the form such that it is possible to compute the earth's magnetic field component for any point on the earth's surface or in space. The higher-order terms give a

good representation for the regional anomalies. Magnetic components may be expressed (5) as approximate derivatives of the magnetic potential, V, which is given in the form:

$$V = a \sum_{n=0}^{n=\infty} \sum_{m=0}^{m=\infty} \left[ \left(\frac{a}{r}\right)^{n+1} \left( I^m_{n_c} \cos m \phi + I^m_{n_c} \sin m \phi \right) + \left(\frac{r}{a}\right)^n \left( E^m_{n_c} \cos m \phi + E^m_{n_s} \sin m \phi \right) \right] P^m_n \cos \theta$$

where $a$ = earth radium ($K_m$)

$r$ = radius from earth's center ($K_m$)

$\phi$ = longitude (rad)

$\theta$ = latitude (rad)

$I$ = constant coefficients

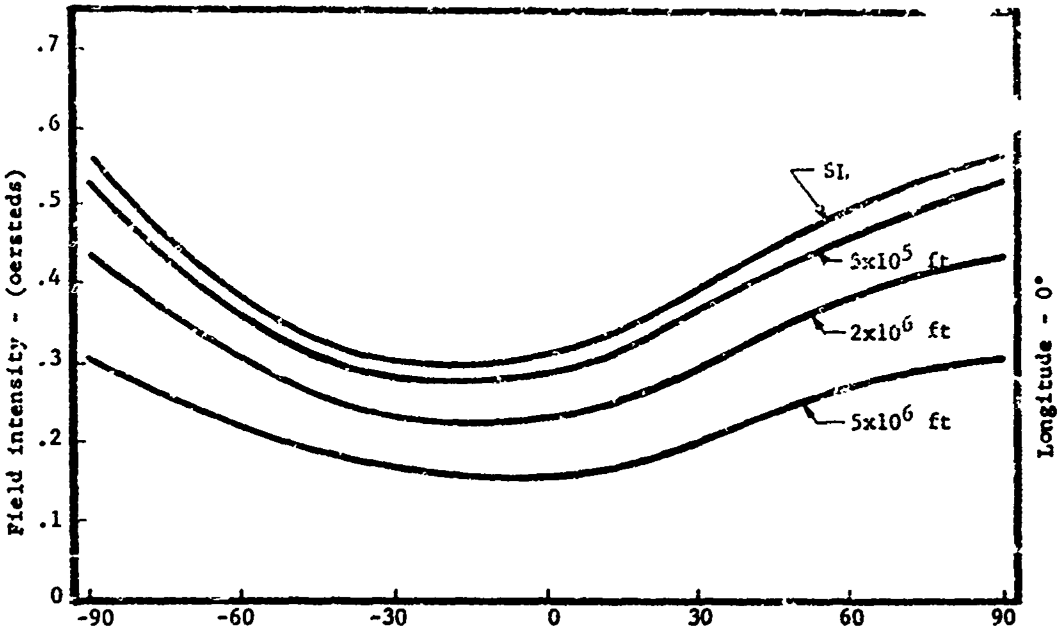
$E$ = constant coefficients

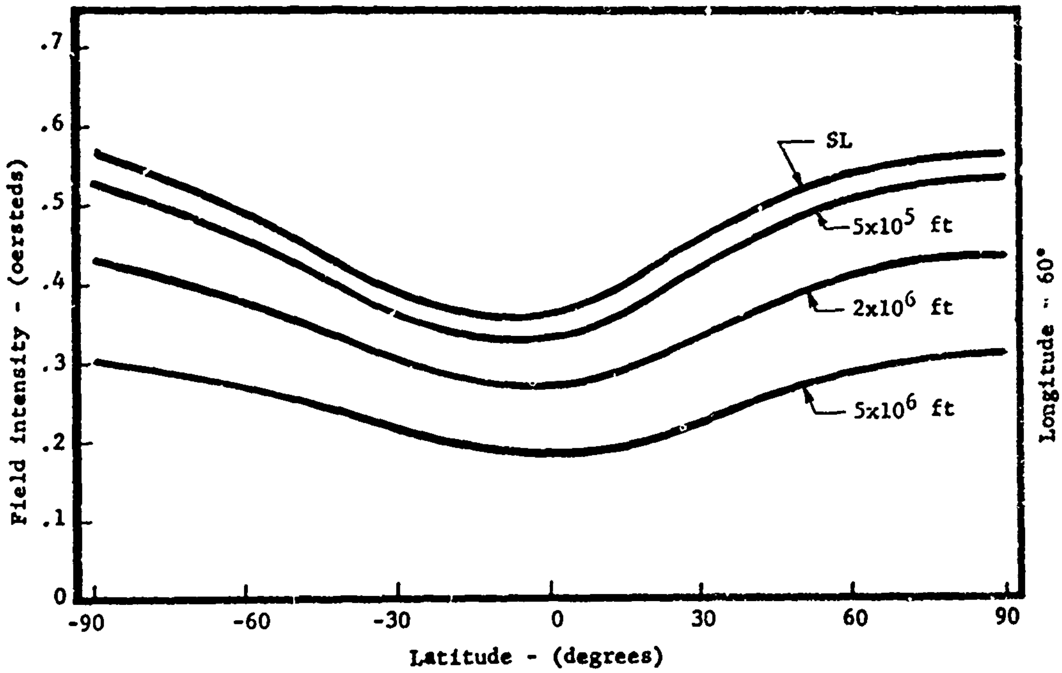
$P^m_n$ = Legendre Polynomials of degree n and order m.

The left portion of the expression within the brackets represe... ...gnetism originating within the earth's sphere, while the right portion ...presents magnetism originating outside the sphere. The coefficients as derived in the spherical harmonic analysis indicate that all but a small percent of the earth's field is due to causes within its surface. This percent varies with altitude and sunspot activity--the latter of course cannot be accounted for in the equation since it is a stochastic variable both in time and magnitude. Plots of the magnetic intensity versus latitude for altitudes up to 1,000 miles and 60° longitude increments are given in Figures 45 through 50.

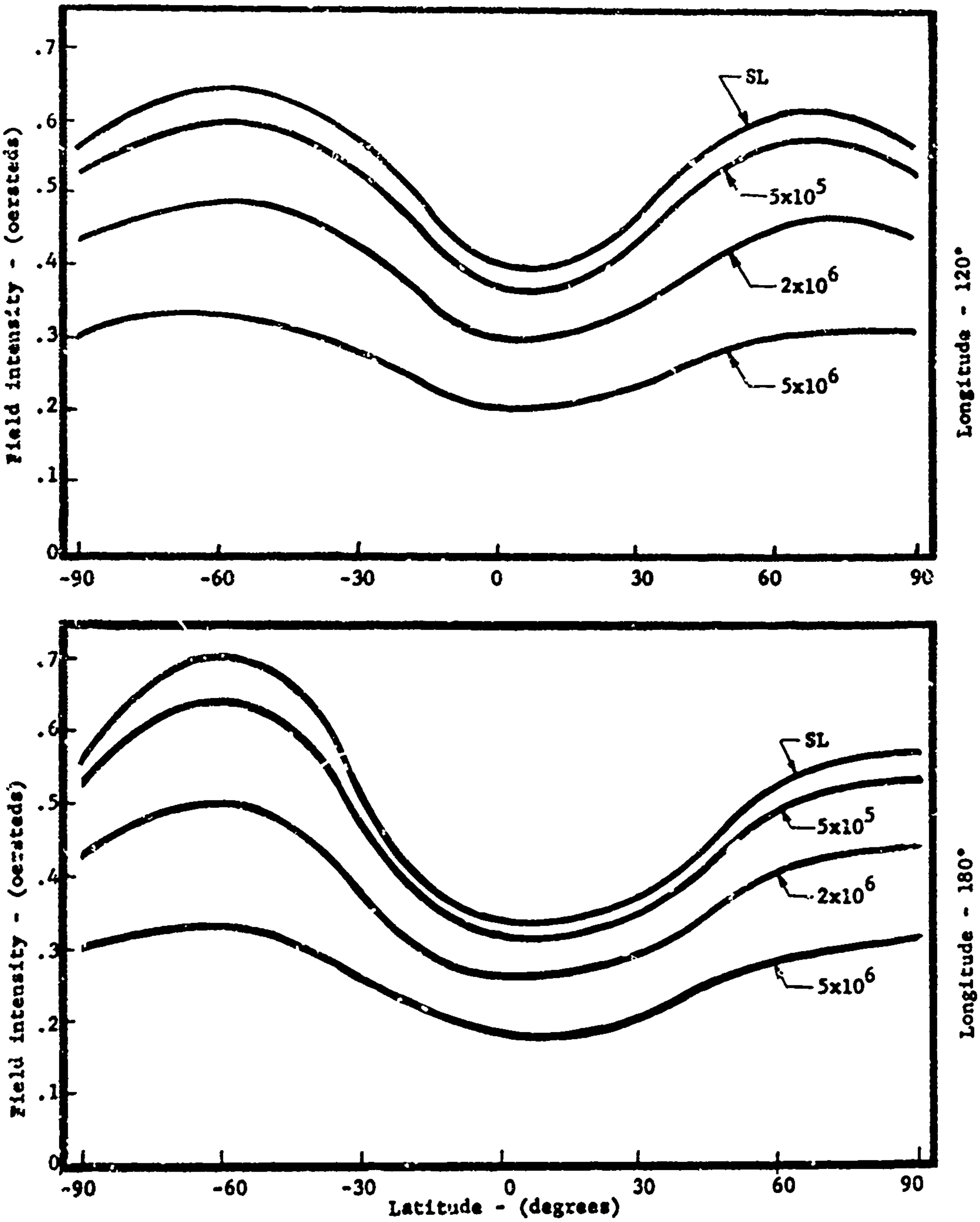
A computer program for solution of the above magnetic potential expression is maintained by the Air Force at Kirtland AFB, New Mexico and is available in several forms including a 704 Fortran and an ALGOL subroutine. Capt. J. A. Walsh and Mr. R. W. Murray of the Air Force Special Weapons Center, Physics Division, Kirtland AFB, maintain the program. The program is available on request from the AF Special Weapons Center or on a 7090 program from the Lockheed-Georgia Company. Major contributions have been made in this field by Dr. James Heppner, of NASA Magnetics Space Program, Goddard Space Flight Center, and the Air Force Cambridge Research Center. The latter has done extensive study on extrapolation techniques that give accurate data at all altitudes (6).

A table of magnetic field intensity for various latitude, longitude, and altitudes is given as Appendix I of this report. This table was compiled

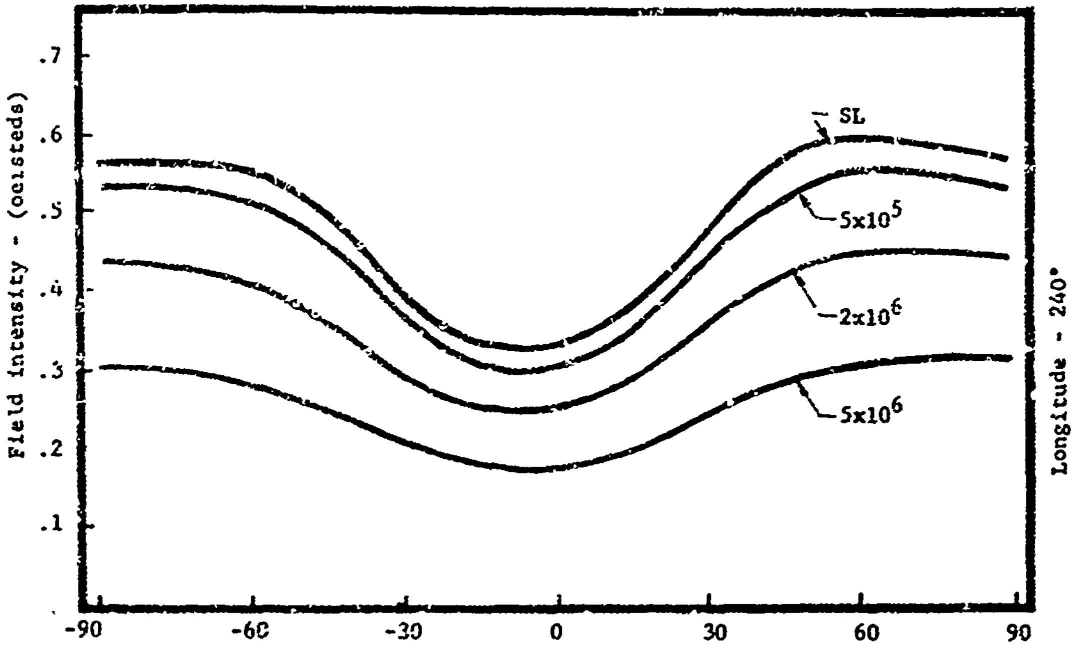


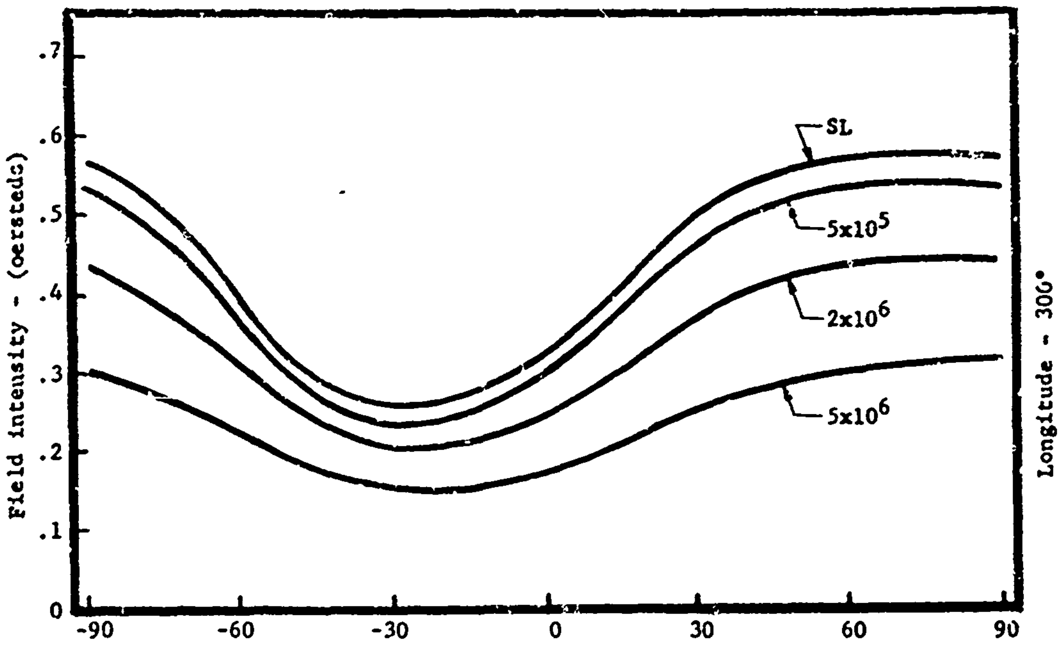




Figures 45 and 46, Magnetic Field Intensity at 0° and 60° Longitude




Figures 47 and 48. Magnetic Field Intensity at 120° and 180° Longitude




Figures 49 and 50. Magnetic Field Intensity at 240° and 300° Longitude

using a 7090 adaption of the AFSWC computer program mentioned above. Because of the vast amount of input from geomagnetic surveys, including satellite measurements, the computer program yields data that are within 1% accuracy. This, of course, does not take into consideration local anomalies but does include the regional anomalies. The tabulation gives the total field intensity and the x, y, and z components in the units of oersteds.

An analysis of magnetic data from the Vanguard III satellite (1959) is given in Reference 7. One of the purposes of this work was to compare the actual field measurements with computed values. Although mathematical expressions have been derived for definition of the earth's magnetic field at the surface, there was some question as to whether extropolation techniques would yield suitable data for extra-terrestial field intensity. Results of the analysis of the Vanguard data indicate that the computed values are within 1% for all measured points.

## Magnetic Variations

There are numerous variations which alter the earth's magnetic field with respect to location and time. Magnetic field variation in respect to location as caused by local anomalies can be of major significance at the earth's surface but loses importance with altitude such that above 100,000 feet it can generally be disregarded. The variation of the magnetic field with respect to time is primarily a result of magnetic storms, with all other causes producing variations of less than one percent at the earth's surface.

There have been little published data to date on field intensity variations at orbital altitudes during magnetic storms. The limited measurements available indicate a peak change of 170 gammas at an altitude of 800 miles. However, extensive measurements have been made on the surface with changes of 10 to 15 gamma per second for 30 seconds or more occurring during intense storms (1 gamma = $10^{-5}$ oersteds). During great magnetic storms the variations of magnetic intensity may be as large as 5% of the total field strength at the high latitudes and about 2% at lower latitudes. These storms occur about once a year on the average. Values of one tenth the great storm variations can be expected to occur several times a month. Analysis of the surface data indicates that the causes of time variation of the magnetic field lie chiefly outside the earth with 35% or less of the variation being of internal origin. The effect of the Van Allen radiation belts on the magnetic field intensity does not appear as significant as the magnetic storm phenomena except at the boundaries of the radiation belts. However, there is little substantiation data in this area and the overall level of change of field intensity due to the radiation belts is not presently available.

A world map in geomagnetic coordinates as well as isoclines for total, horizontal, and vertical magnetic intensities is given in Reference 8. Included in Reference 8 is a relatively complete discussion on variation nomenclature and tables on magnetic field variations as derived from many years of observations at numerous stations distributed around the earth's surface.

Magnetic Torquing for Attitude Control

The concept of using magnetic reaction against the earth's field for satellite attitude control has recently been an area of extensive investigation. A score of magnetic torquing devices have been discussed in the technical literature such as in References 3, 5, and 9. Practical design equations have been derived to enable determination of the torque, size, weight, and energy requirements for design of magnetic torquing devices. By means of the equations, nomographs, and data tables that are contained in Reference 5, rapid design of magnetic torquing devices is possible.

A sample calculation for an external air-core coil is as follows (5):

$$T = n\ i\ A\ F_e \sin\theta$$

where

$T$ = torque measured (dyne - centimeters)

$n$ = number of turns in the coil

$i$ = current (abamperes)

$A$ = air core area ($cm^2$)

$F_e$ = magnitude of earth's magnetic field (oersteds)

$\theta$ = angle between the coil axis and the earth's magnetic field vector (radians)

If

$F_e$ = .30 oersteds

$D$ = (coil diameter), 152.4 cm (5 feet)

$A = \frac{\pi}{4}(152.4)^2 = 1.828 \times 10^4\ cm^2$

$\theta \approx \frac{\pi}{2}$ rad

$n$ = 100 turns (#17 copper wire)

$i$ = .12 abamp

$T = (100)(.12)(1.828 \times 10^4)(0.3) = 6.58 \times 10^4$ dyne-cm

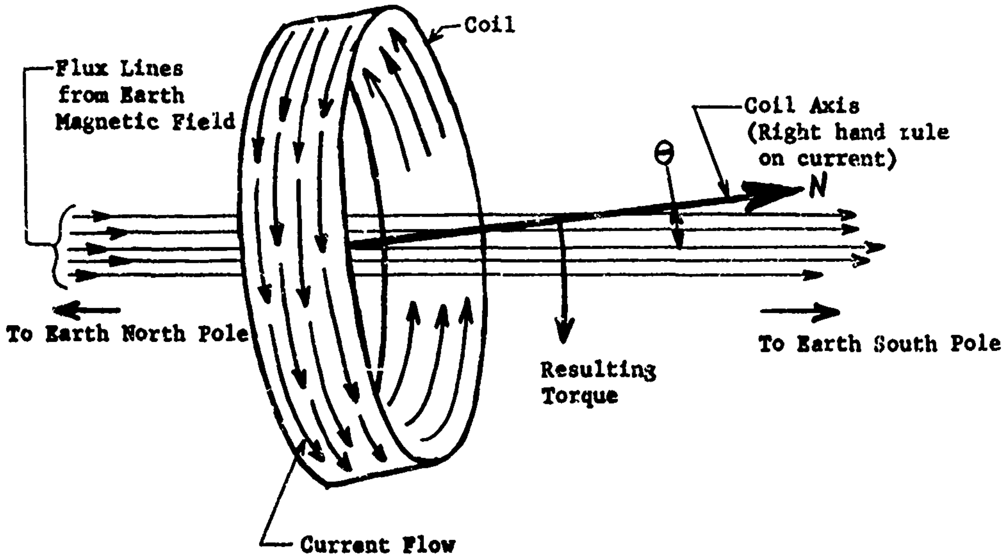
= .93 oz-inches, this requires 1,570 feet #17 wire

which weights 8.85 pounds.

Resistance = 7.22 ohms @ 20°C

Power required = $i^2R = (1.2)^2\ (7.22) = 10.4$ watts of input power.

This relationship is illustrated by the following diagram:




From analysis of the various equations and studies that have been made, it is apparent that a system can be built that will yield a minimum of 25 oz-inches of torque for less than 50 pounds of weight and requiring less than 50 watts of power for orbital altitudes up to 1,000 miles. Of course, the amount of torque a given coil can produce varies as a function of the magnetic field components.

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## SOLAR RADIATION

Solar radiation, when analyzed for its effect on the design of flight control systems for earth orbiting vehicles, can be classified into two closely related categories of influence. The first is the force exerted on the vehicle and the cyclic fluctuations of solar light pressure, and the second is the variation of atmospheric density and therefore drag due to the cyclic variations of the sun's radiation field.

### Solar Pressure

Solar pressure can be described as the pressure exerted by the sun on each of its satellites due to the effects of its radiated light. The free space intensity of solar radiation flowing per unit time through a surface of 1 $in^2$ placed normally to the light direction at the earth's mean solar distance ($4,910 \times 10^{11}$ feet) is known as the solar constant of radiation, S, and has the value (1):

$$S = 0.655 \text{ ft-lb in}^{-2}\text{sec}^{-1}$$

If the radiation is to be considered over a long time period, it is necessary to include the effect of change in distance between the earth and the sun. Because of the eccentricity of the orbit of the earth, the solar constant varies between perihelion and aphelion as indicated below:

| | Earth - Sun Distance In ft. | Energy of Sun's Radiation In ft-lb $in^{-2}sec^{-1}$ |
|---|---|---|
| Perihelion | $4.83 \times 10^{11}$ | 0.665 |
| Aphelion | $4.993 \times 10^{11}$ | 0.645 |

The earth-satellite distance is usually negligible when compared to the earth-sun distance. For example, in the case of a satellite at a distance of nearly 6 earth radii, the error in radiation intensity is only 0.12% using the earth-sun distance instead of the sun-satellite distance.

In the vicinity of the earth, the sun's light is to be considered as a system of plane, finite, electromagnetic waves, traveling in empty space. By Maxwell's electromagnetic theory, an impulse in the direction of the beam is associated with each wave. The total radiation pressure, $P_0$, is the ratio of the solar constant, S, to the velocity of light, c, and is equal to $6.67 \times 10^{-10}$ pounds per square inch at the mean earth-sun distance.

If the light rays form an angle $\alpha$ with the surface normal, the force is given by:

$$F = P_o A \cos \alpha$$

where $A$ = area of surface ($ft^2$)

The force experienced by the surface will tend to move the body away from the sun. It is assumed here that the body is not transparent and that it is a perfect absorber, i.e. has zero reflectivity. Each of these factors is a function of the wave length and angle of incidence and must be considered in detailed calculations as indicated in Reference 1. If the surface were a perfect reflector, for example, the force would be twice the value indicated. Satellites are generally composed of shapes such as spheres, cylinders, cones, and planes. For those surfaces which are not normal to the radiation or symmetrical with relation to it, there are force components that give lateral displacements.

Generally the radiation force may be expressed, as shown in Reference 1, as:

$$F = P_o \times A \times C_F$$

where A is the projected area of the body and $P_o$ is the radiation pressure in the vicinity of the earth. The function $C_F$ was introduced in analogy to the aerodynamic expression for the drag, and may be called the "radiation force coefficient." Its value (1) depends upon the transparency and reflectivity of the surface. $C_F$ is limited by:

$$0 < C_F \leq 2$$

For: Plane Surfaces -------------------- $0 < C_F \leq 2$

Spheres -------------------------- $0.75 \leq C_F \leq 1.25$

Cylinders ------------------------ $0.862 \leq C_F \leq 1.471$
(Illuminated perpendicularly to the axis of symmetry.)

Cones in Special Positions---------- $0 < C_F < 2$

Parabolic Bodies ------------------ $0 < C_F < 2$

In summary, it can be stated that the radiation force acting on a satellite is a function of the following quantities:

1. The sun-satellite distance.
2. The size and shape of the surface.
3. The optical properties: reflective ratio and transparency ratio.
4. The angle of incidence of light, $\alpha$.
5. The distribution of the radiation energy in the solar spectrum.

An item of importance in determining solar pressure effects on a satellite is the force that is introduced due to the re-radiation of sunlight from the earth. When the sun is overhead, a satellite at a typical height experiences an upward push due to the reflected component of sunlight amounting to at least 20 percent of the downward push of the direct sunlight (2). When the sun is at larger zenith distances, the effect is less important, but is complicated by the fact that the repulsive force is no longer quite radial from the center of the earth. Over the entire earth the magnitude of the mean outward force due both to the reflected sunlight and to the infra-red radiation by the surface and atmosphere is less than 20 percent of that due to direct sunlight (2) for satellites with perigee heights greater than 500 miles. Although the effects of solar pressure resulting from radiation reflected by the earth is not elaborated on in detail in this report, it is an item that should be given careful consideration in the overall solar disturbance analysis.

## The Perturbing Acceleration Due to Radiation Pressure

The disturbances that are imparted to a satellite due to solar pressure are perturbing accelerations of the orbit. Their perturbing accelerations, termed the "secular acceleration," change the period from one revolution to the next. In this discussion the term "acceleration" refers to the non-dimensional quantity $\Delta P/_P$ where P is the period of an orbital revolution.

To determine the rate of change in orbital period (the secular acceleration) of a satellite due to the effects of solar pressure the following expression has been derived in Reference 2:

$$\Delta P/_P = 1.40 \times 10^{-7}\, D_s\, K^2\, \frac{(1+e)}{(1-e)}\, \sin i' \left[\frac{\cos(\beta+\theta)}{1+e\cos\theta}\right]\Bigg|_{\theta_1}^{\theta_2}$$

Where:

| | | |
|---|---|---|
| P | = | the orbital period (days) |
| $D_s$ | = | $A/_m$ (A = area and m = mass of satellite) ($cm^2/_{gm}$) |
| K | = | $a\,(1-e)/_{R_\oplus} \equiv q/_{R_\oplus} \geq 1$ |
| a | = | length of semimajor axis of orbit ($K_m$) |
| i' | = | angle of inclination of sun normal to the satellite orbit normal (deg) |
| e | = | orbit eccentricity |
| $R_\oplus$ | = | radius of cylinder generated by earth's shadow ($K_m$) |

$\beta$ = angle between the perigee-earth line and the intersection of the orbit plane and a plane normal to the orbit through the sun-earth line. (deg)

$\theta$ = angle between earth-erigee line and earth-satellite line (deg)

To evaluate the bracket in this equation one must know the values of the true anomaly, $\theta_1$, and $\theta_2$, the angles at which the satellite enters and leaves the earth's shadow. To keep the problem tractable assume, without appreciable error, that the shadow is a circular cylinder of radius $R_{\oplus}$ with its axis in the anti-sun direction. In polar coordinates the values of $\theta_1$ and $\theta_2$ are the solutions of

$$\frac{R_{\oplus}^2}{1 - \sin^2 i' \cos^2 (\beta+\theta)} = \frac{a^2 (1-e^2)^2}{(1+e \cos \theta)^2} \qquad \frac{\pi}{2} \leq \beta+\theta \leq \frac{3\pi}{2}$$

If there are no solutions in the second and third quadrants the satellite is in sunshine all around the orbit. If there is one solution, $\theta_1 = \theta_2$, the satellite touches the shadow at only one place and spends none of its time in darkness. Since $\theta/R_{\oplus} = K \geq 1$, then $\theta_1$ and $\theta_2$ are the two solutions of:

$$(1+e \cos \theta)^2 = K^2 (1+e)^2 \left[1-\sin^2 i' \cos^2(\beta+\theta)\right], \quad \frac{\pi}{2} \leq \beta+\theta \leq \frac{3\pi}{2}$$

The specific values of $\theta_1$ and $\theta_2$ for a given high altitude satellite can be found by computing $i'$ and $\beta$ for every few days and solving the equation above by graphical or other approximate methods.

A general solution of the equation for $\Delta P/p$ is formidably complex because the angles of entry and exit depend on several arbitrary parameters. For some specific applications one might consult References 2 and 3 which explain the effects of radiation pressure on the period changes of a high altitude satellite. A quasi-general solution as a power series in the eccentricity may also be found in Reference 2.

## The Relationship of Radiation Pressure and Atmospheric Drag

In order to more clearly define the overall effects of solar pressure upon the stability of an orbiting satellite, a brief comparison with atmospheric drag is presented in Reference 2. It is well known that the instantaneous tangential acceleration of a satellite moving through a stationary atmosphere is given by:

$$T = (A/m) (C_D/2) \rho V^2$$

where: $C_D$ = dimensionless drag coefficient

$P$ = atmospheric density ($gm/cm^3$)

$A$ = reference area ($cm^2$)

$m$ = reference mass (gm)

$V$ = speed of satellite ($K_m$/sec)

When the magnitude of this perturbing acceleration is compared to that due to solar radiation pressure, the ratio of the two is found to be approximately unity (assuming the circular velocity) at a 500 mile orbit and a mean density of the atmosphere at this altitude (4). When the sun is active and when it is close to midday at the perigee of a satellite, the high atmosphere is distended and the level of equal magnitudes is above 500 miles.

Although solar pressure does not have a very large direct effect on the smaller lower satellites, the indirect effects due to the variations in solar radiation have a very definite result. Erratic changes in the accelerations of a satellite were first detected in an analysis of observations of 1957 Beta I (5, 6 and 7). At first it was not clear whether these changes were due to variations in the presentation area of the satellite or to density variations in the atmosphere; but when their presence was detected also in the spherical Vanguard Satellite 1958 Beta II, no doubt was left about their atmospheric origin. The presence of a 27-day periodicity pointed to variable solar radiation as the cause of the atmospheric fluctuation. The discovery that the accelerations of 1958 Beta II and 1957 Beta I varied more or less in unison (7), and that those of the other satellites followed the same rhythm, proved that the atmospheric fluctuations in general are truly global.

A remarkable similarity was found by Dr. W. Priester of Bonn, Germany between the acceleration curves of 1957 Beta I and the 20-cm solar flux curve in the interval of November 11, 1957 to February 10, 1958. Also Jacchia found a similar correlation between the 10.7-cm solar flux data of the same period; and a comparison of the satellites' acceleration curves with these data, extended over a whole year, showed a correlation which could be classified as little short of perfect (7). They amounted to about 20 percent in typical, well-defined, 27-day cycles in the accelerations of 1958 Delta I (perigee height 120 miles); but to about 70 percent in corresponding cycles of 1958 Beta II (perigee height 400 miles). The 10.7-cm radiation is closely correlated with sunspot activity, so that an excellent correlation also exists between satellite accelerations and solar activity. For further correlation, data from observations of 1958 Beta II (about 2,500 readings) and of 1958 Delta I (about 9,000 readings) were reduced by the best possible means to obtain as accurately as possible the two satellite accelerations. These results were plotted (7) together with the 10.7-cm solar radiation curve, as shown in part of Figure 51. As can be seen, the correlation with solar radiation is remarkably good, even in details for the Vanguard Satellite 1958 Beta II, for which accurate, well-distributed Minitrack observations were available throughout. For the 1958 Delta I the

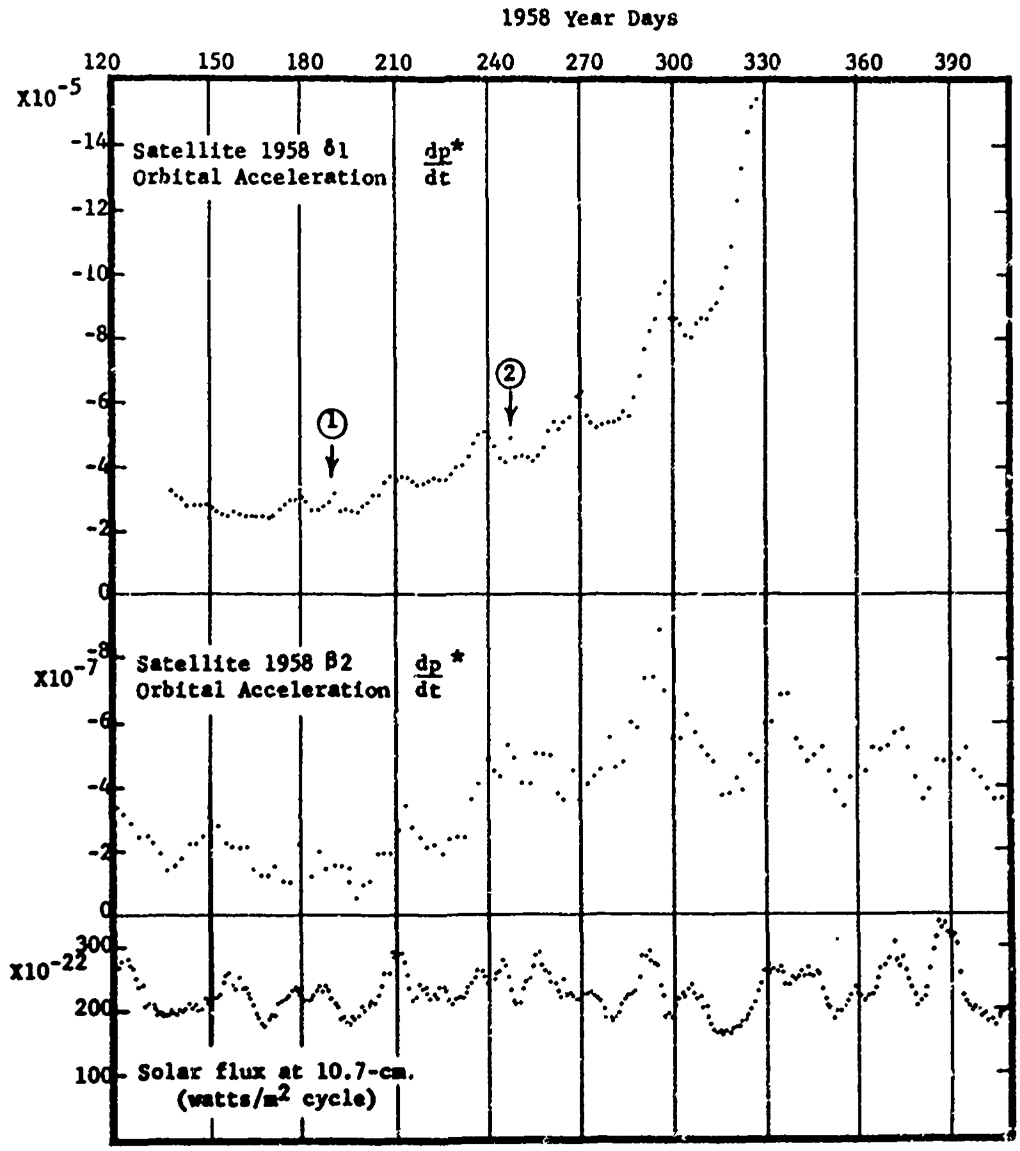


Figure 51. Secular Acceleration of Satellites 1958 Delta I and 1958 Beta II Compared to 10.7-cm Solar Flux

* Non-dimensional ratio (P = period of revolution; t = time)

observations are mostly optical, less accurate, and more irregularly distributed, with occasional periods of near-invisibility. This fact, together with the elogated shape, may have contributed somewhat to the poorer correlation for this satellite.

The residual curve for 1958 Delta I is a succession of long, smooth waves of great amplitude which are mainly due to the 27-day fluctuations. At only two spots in the whole curve is the smooth succession of long waves interrupted by a transient, short-lived but unmistakable, secondary oscillation. The dates of these disturbances are July 8 to 9 and September 4, 1958; they are exactly coincident with the only two great geomagnetic disturbances that occurred during the satellite's lifetime. Both magnetic storms followed at the usual one-day interval after the appearance of a flare of importance -3 on the sun. The increase in the acceleration amounted to 40 percent in the July 8 event and to a little more than 30 percent in the event of September 4. These are actually lower limits, inasmuch as the limited resolution may have smoothed out peaks. As can be seen in Figure 51 the two disturbances are marked 1 and 2 respectively. No disturbance could be detected in the residual curves for 1958 Beta II around the two critical dates in July and September. This could be due to the much smaller value of the acceleration for this satellite, which according to Reference 7 would make the short-lived perturbation difficult to detect.

From curves for satellites 1958 Alpha and 1958 Beta II, as shown in Figure 52, a major perturbation of the atmosphere can be seen which started in the second half of August 1958, and continued for two or three months, and possibly longer. This perturbation occurred when the perigee of 1958 Alpha was in daylight and raised the acceleration level to extremely high values which were never reached again even when the perigee returned to the same position with respect to the sun the following year (April to August 1959). The global nature of the perturbation is evidenced by the extremely rapid and perfectly synchronous rise in the accelerations of both satellites between August 17 and August 27, 1958. The curve of the 10.7-cm solar flux does not offer any clear-cut clue to the cause of this perturbation.

For the sake of comparison it is interesting to note the relative influence of drag and solar pressure upon a satellite such as Echo I. Plots of the rate of change of period (P) due to atmospheric drag and to solar radiation pressure are shown in Figure 53 from Reference 8. Data for this figure were obtained by computing the solar pressure acceleration and subtracting this from observed accelerations to obtain the accelerations attributed to air drag. The notation is made that radiation pressure can have no effect on the period if the orbit is circular (2). However, if the orbit is non-circular and is partly in shadow, the satellite can enter and leave the shadow region at different distances from the sun, resulting in a net gain or loss of energy from the radiation field. As can be seen, the radiation pressure contribution to acceleration is, in general, of the same order of magnitude as that of drag at the orbital altitudes of Echo I. Paradoxically, when perigee height is near its minimum value, the change in energy induced by radiation pressure is still comparable to that due to

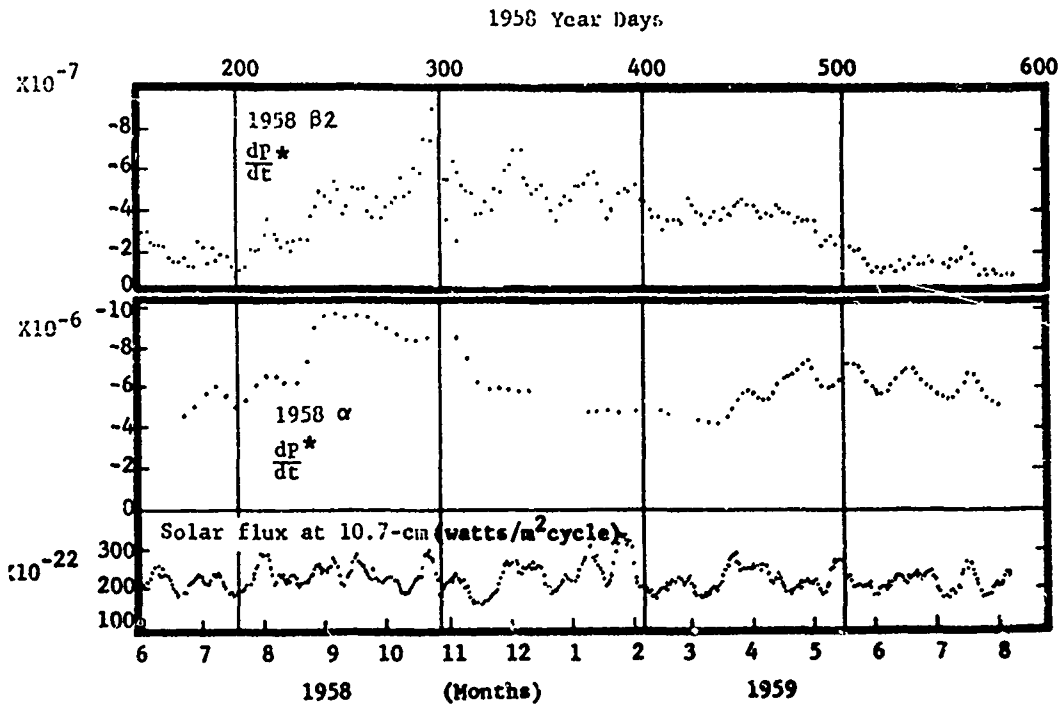


**Figure 52.** Secular Acceleration of Satellites 1958 Beta II and 1958 Alpha, Compared with 10.7-cm Solar Flux.

* See Figure 51.

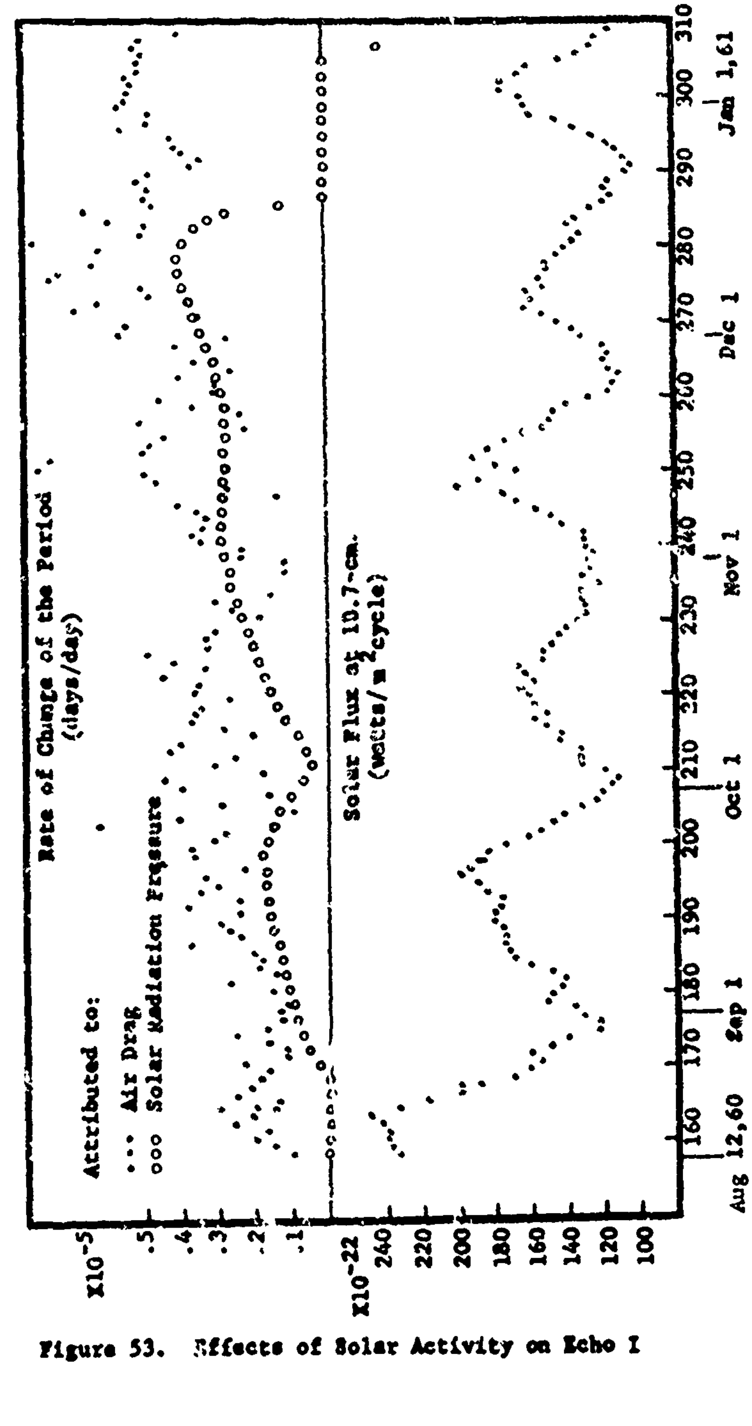


Figure 53. Effects of Solar Activity on Echo I

air drag, despite the increased air density. These facts can be understood in a quantitive way from the following argument from Reference 8. If the air density depends only on height, then as a function of eccentricity, the energy change due to air drag in one revolution is represented by a constant term plus terms in even powers of the eccentricity. On the other hand, when the qualifications given above are satisfied, the energy change per revolution due to radiation pressure is represented by a linear term plus higher powers of the eccentricity; hence, the energy change due to radiation pressure can increase more rapidly with increasing eccentricity than can the energy change due to air drag when the atmospheric scale height is large. This provides a reasonably qualitative explanation of the results in Figure 53.

As may be seen from the end of the graph in Figure 53, the satellite lost energy to the solar radiation field until the end of December 1960; then the satellite stayed in sunlight throughout its complete orbit for about two weeks. In January 1961, the satellite began to gain energy from solar radiation in the manner described above. In fact, during the latter part of January, the satellite gained more energy from the solar radiation than was lost due to air drag. This marked the first time that an artificial satellite exhibited an actual increase in period.

Atmospheric Drag

Atmospheric density, as seen from the previous paragraphs on satellite response to solar pressure, is also a cyclic variable. Studies of the upper atmosphere made in recent years have revealed large variability of atmospheric density at high altitudes and show that it is no longer possible to use a single density curve such as that of the ARDC (1959) model atmosphere without introducing errors of many percent and even, at high altitudes, orders of magnitude. The object of this portion of the report will be to describe the improvements in the knowledge of the atmosphere which have accrued in recent years. An excellent treatment of this subject, from which the remainder of this subsection is largely taken, is given in Reference 9.

Below 50 n.m. many observations are available from rockets and radiosondes. Based on a detailed analysis of this data, Group I of COESA (Committee on Extension, Standard Atmosphere) is presenting a revision of the 1959 ARDC Standard Atmosphere (10), of which preliminary information is already in print (11, 12). The COESA group has announced its decision to construct not one, but nine standard atmospheres for the 0-55 mile range, corresponding to different seasons and latitudes. In addition, one mean atmosphere was devised to replace the ARDC model. It agrees rather closely with that earlier model, differing by a few percent at some altitudes.

These improvements can be incorporated most simply into present calculations by applying a correction factor to the 1959 ARDC densities to account for the seasonal-latitudinal variation. The correction factors will be found under the heading of Density Approximations below.

Above 50 n.m. density observations are infrequent. In the absence of more specific data use of the corrected ARDC atmosphere up to 76 n.m. is

suggested. The 76 n.m. region is the approximate transition where solar effects begin to dominate atmospheric conditions.

Atmospheric absorption of ultraviolet radiation from the sun is the primary phenomenon determining air density at altitudes higher than about 80 n.m. above sea level. The density is found to depend upon the coordinates of space and time in four principal ways, each of them related to the solar influence.

1. Altitude Dependence - Density observations from satellite orbit decay become frequent above 80 n.m. and continue out to about 350 n.m., becoming rather sparse above 200 n.m. Higher than this, one has only the somewhat inconclusive data from Echo I. The existing information shows that the density profile is only approximately exponential. Various theories have been proposed to explain this departure from the exponential decline which exists near the earth's surface. Nicolet (13) has had the most success by assuming that solar ultraviolet radiation, UV, is absorbed in the atmosphere in an altitude layer between 54 and 108 n.m., and that isothermality is maintained above some level by molecular diffusion.

Reduction of satellite data and construction of density profiles for the 108-378 n.m. region have been performed recently by Jacchia (14) of the Smithsonian Astrophysical Observatory (SAO), King-Hele and Walker (15) in Great Britain, and Paetzold (16, 17) in Germany. Jacchia's, although the oldest, has several recommending qualities over the British and German models: (a) Jacchia has derived an emperical analytic expression (presented below) for the density; (b) the results agree almost exactly with those obtained from another study (9) using quite different reduction methods; and (c) in the light of Nicolet's calculations, the shape of Jacchia's density profile is more credible than that of the other two. The SAO model is thus closely fitted to observed data, in agreement with theory, and expressible in usable analytic form.

Between 76 and 108 n.m. a curve has been interpolated to connect ARDC and SAO models. The interpolation is based on data from low orbits (Discoverers, etc.) as analyzed from studies made in Reference 9. Above 378 n.m. the data curves have simply been extended in general agreement with Echo I data reduced by SAO (18) and by Bonn University Observatory (19).

2. Diurnal Variation - The profile discussed above is not constant, however, owing to its dependence on solar ultraviolet radiation. The flux of this radiation impinging upon a point in the absorption layer is subject to various periodic fluctuations of large amplitudes. These fluctuations in incident radiation are reproduced in the high-altitude air density. The relative amplitude of the density fluctuations is about the same as that of the radiation fluctuations; and, for simplicity, Jacchia takes density as strictly proportional to solar flux. There is a slight time lag introduced on account of the finite heating time of the atmosphere.

The most important of these fluctuations over any given longitude is due to the diurnal rotation of the earth (solar radiation at a point in the atmosphere reaches a maximum at noon and falls off to zero at night).

The density distribution takes a finite time to adjust to this daily heating cycle, so that the maximum daily density is not achieved until two hours after noon. The night-time density is fairly constant near a minimum value, the atmosphere retaining some portion of the solar energy absorbed on the previous day. The amplitude of the daily variation increases markedly with altitude, starting at 30% at 114 n.m. and reaching 900% at 354 n.m. As might be expected, the effect displays a strong latitude-dependence, being most pronounced near the latitude of the sun.

It is convenient to picture the diurnal effect as a spatial distribution of the air mass about the earth. The entire dark hemisphere will have low density; the bright hemisphere will have a density peak located about 30° (2 hours) due east of the sub-solar point. The density distribution is pictured as a "bulge," axially symmetric about the peak. It can be expressed as an even function of $\Psi$, the geocentric angle between the peak of the bulge and the field point.

3. Eleven Year Variation - One of the longest known solar phenomena is an eleven year activity cycle: Sunspot numbers and radiation flux measured at the earth's surface display oscillations of 50% or more about their average. A corresponding variation in ultraviolet intensity can send the high-altitude density varying up and down by more than a factor of 3. King-Hele and Walker (15) have noted that density decreased by a factor of about 1/2 between 1958 and 1960 (the peak of solar activity having occurred in 1957-1958).

This effect is so large as to render meaningless any average density curve totally independent of time. Multiplying the average density by a time-varying function of eleven year period will resolve the difficulty. Jacchia (14) has chosen to moniter the decimeter solar flux as an index of solar activity at ultraviolet wave length. This monitor is then applied as a multiplicative correction to the density profile of paragraphs 1 and 2.

4. Twenty-seven Day Variations - The decimeter-band of the solar flux also displays a fluctuation of irregular form and 27-day period (due to the sun's rotation), which is also duplicated in high-altitude air density. Jacchia used the 20-cm flux as an indicator of ultraviolet intensity, but most observers (11, 14, and 18) now find the 10.7-cm flux measured at Ottawa to be more reliable. A normalization factor of 0.85 must then be applied to Jacchia's formula (see Density Approximations).

For most general applications, current flux readings are unavailable. A "mean level" of solar intensity, displaying the large eleven-year variation, can be inserted into the equations and the 27-day fluctuations carried as a possible 25% error. An approximate expression for this "mean level" is included among the Density Approximations that follow.

Besides these four principal spatial and temporal variations, atmospheric density is subject to various random disturbances. Jacchia (19) has presented good evidence of the influence of magnetic storms. Paetzold (15) has found some indication of an annual and semi-annual effect attributed to interplanetary matter. It must be borne in mind that the accuracy of any atmospheric model is limited.

Using the best available information, air-density profiles have been plotted in Figures 54a and 54b for the mean levels of late 1958 and late 1961, at the peak of the diurnal bulge and at the night-time minimum. This has been done more to indicate the trend and range of the variations than to provide an accurate basis for graphical interpolation. The suggested continuations are indicated above 378 n.m. and below 108 n.m. (becoming tangent to the ARDC curve at 75 n.m.).

### Density Approximations

In the following expressions, the various parameters and geocentric equatorial co-ordinates are defined as follows:

$X, Y, Z$ = Geocentric cartesian coordinates of the field point, where X and Y are in the earth's equatorial plane, (X positive in the direction of the vernal equinox of date; Y positive outward on an axis 90° east) and Z is measured north along the earth's spin axis, (nautical miles).

$R$ = geocentric distance of the field point $= \sqrt{X^2 + Y^2 + Z^2}$ (nautical miles) from center of earth.

$\ell, m, n$ = direction cosines of field point; $\ell = \frac{X}{R}$, $m = \frac{Y}{R}$, $n = \frac{Z}{R}$

$d$ = days elapsed since December 31, 1957

$\lambda s$ = celestial longitude of sun; an adequate approximation in radians is:

$$\lambda s = 0.017203d + 0.0335 \sin 0.017203d - 1.410$$

$E$ = inclination of ecliptic = .4092 rad

$\ell_s, m_s, n_s$ = direction cosines of sun

$$\ell_s = \cos \lambda s \quad m_s = \sin \lambda_s \cos \theta \quad n_s = \sin \lambda s \sin \theta$$

$\Psi$ = geocentric angle between sun and field point

$$\cos \Psi = \ell \ell_s + m m_s + n n_s$$

$\theta$ = longitudinal lag of diurnal bulge: An adequate average is .55 rad

$\Psi'$ = geocentric angle between diurnal bulge and field point.

$$\cos \Psi' = (\ell \ell_s + m m_s) \cos \theta + (m \ell_s - \ell m_s) \sin \theta + n n_s$$

$h$ = altitude above ellipsoidal earth in nautical miles

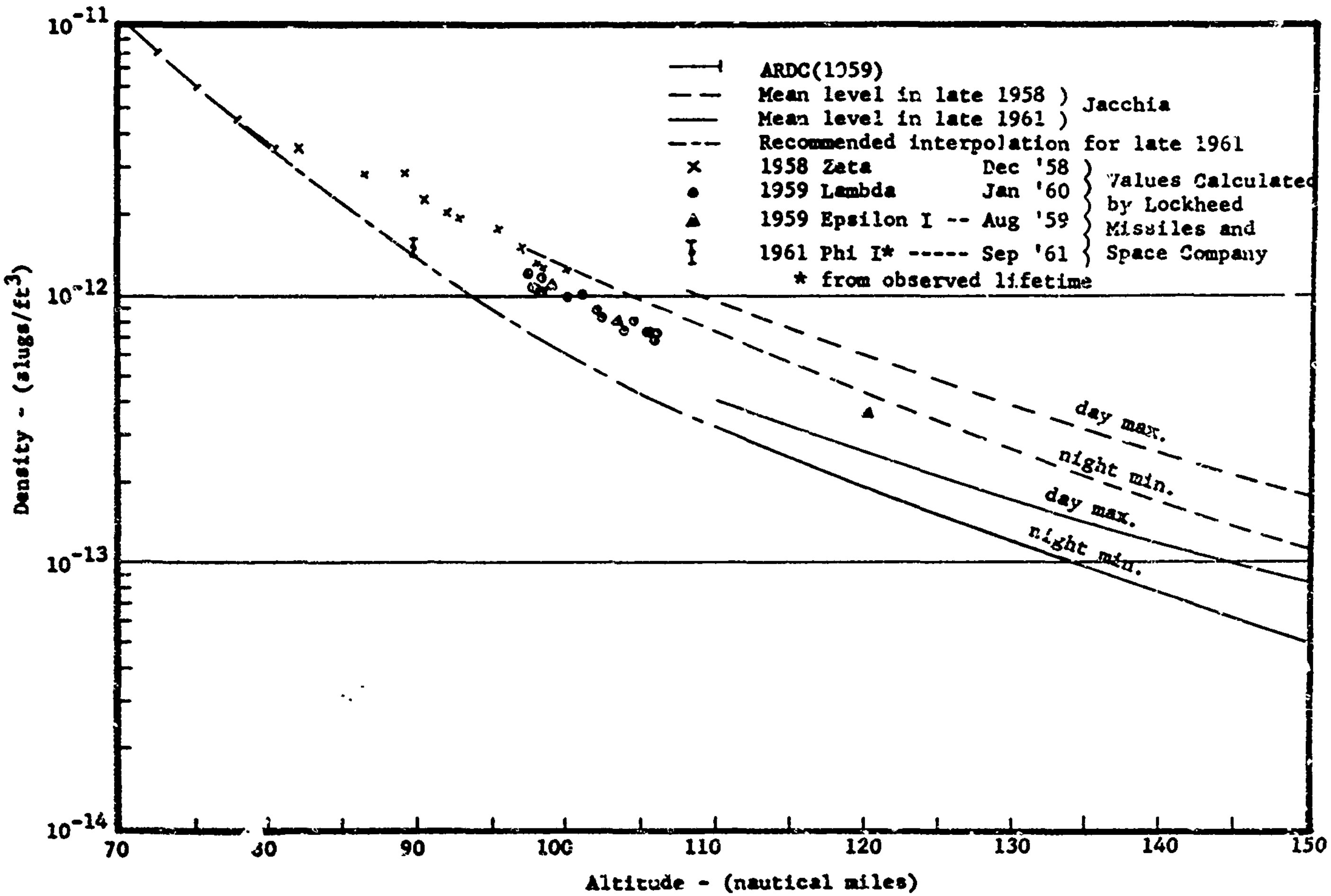


Figure 54a. Atmospheric Density

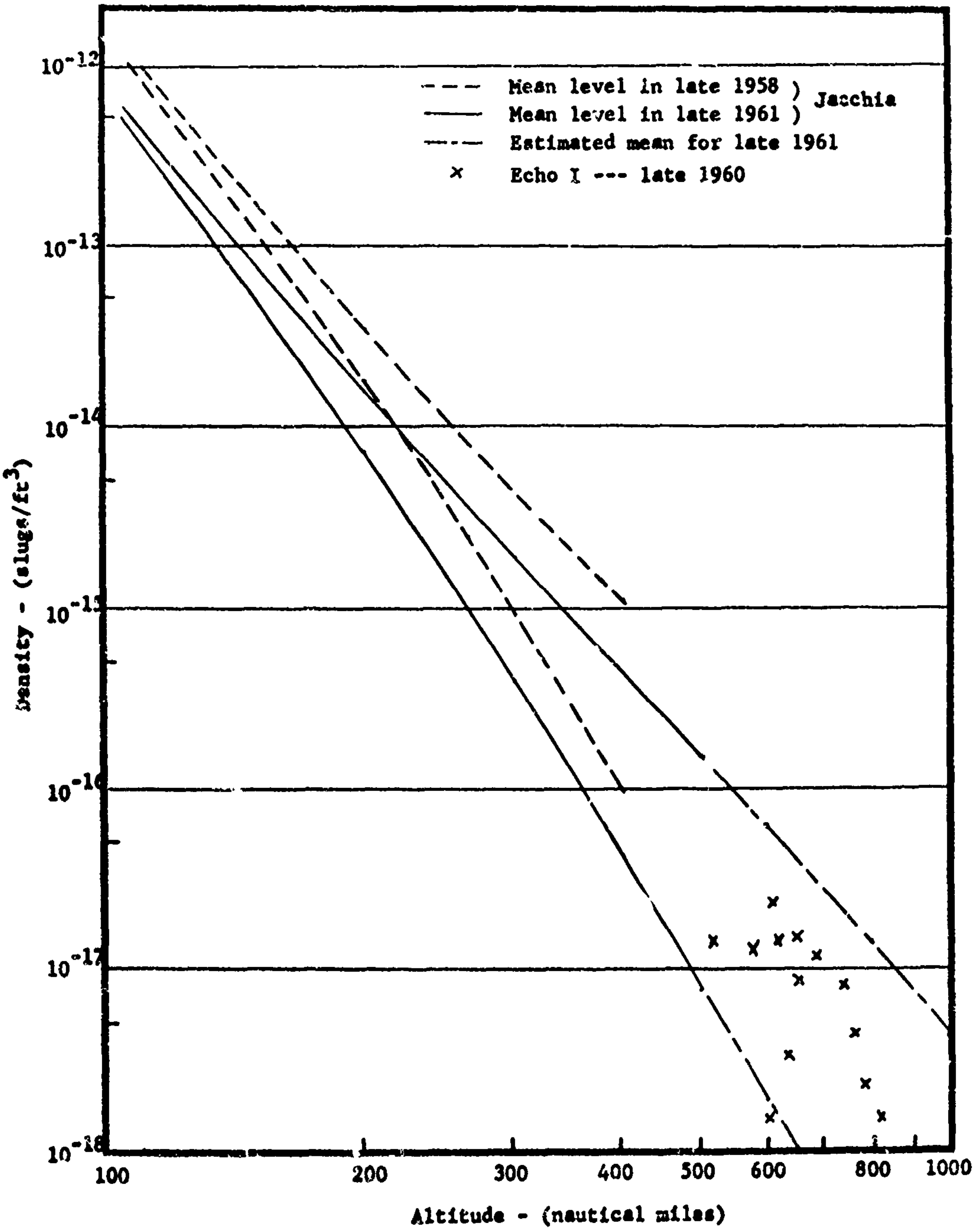


Figure 54b. Atmospheric Density

F = flux of 10.7-cm solar radiation in units of $10^{-20}$ watt/meter$^2$; an adequate approximation is $F \simeq 1.5 + 0.8 \cos(2\pi d/4020)$

$\rho$ = atmospheric density in slug/ft$^3$

The following equations allow a good approximation to atmospheric density for any altitude up to 1,000 nautical miles:

<u>0 to 76 n.m.</u> In this region the ARDC (1959) atmosphere is to be used, with a correction factor of

$$\left\{1 - 0.6\, n^3 \left[1 - \cos 2\pi\left(\frac{h-16}{34}\right)\right] \cos 2\pi\left(\frac{d+9}{365}\right)\right\}$$

applied between 16 and 50 n.m.

<u>76 to 108 n.m.</u> The following formula will serve as a connection between the two bordering regions. The slope of the profile will often be discontinuous at the endpoints:

$$\rho = 5.5\text{x}10^{-12}\, \text{x}\left(\frac{76}{h}\right)^{7.18} \left[\frac{108-h}{32} + 0.85\left(\frac{h-76}{32}\right)^{4/3} F\right]\left[1 + \frac{h-76}{153}\left(\frac{1+\cos \Psi'}{2}\right)^3\right]$$

<u>108 to 378 n.m.</u> Jacchia's formula (14) can be written, using the 10.7-cm flux, as:

$$\rho = \rho_o(h)\ (0.85\ F)\left\{1 + 0.19\left[\exp(0.0102H) - 1.9\right]\left(\frac{1+\cos \Psi'}{2}\right)^3\right\}$$

$$\log_{10} \rho_o(h) = -15.309 - 0.00368H + 6.363 \exp(-0.0048\ h)$$

<u>378 to 1,000 n.m.</u> For these altitudes only an approximate form can be given:

$$\rho = 0.00504\ \frac{F}{h^5}\left[\left(\frac{1+\cos \Psi'}{2}\right)^3\left(1 - \frac{6 \times 10^6}{h^3}\right) + \frac{6 \times 10^6}{h^3}\right]$$

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METEORS

The effect of meteors on control system design and analysis can generally be considered as secondary and for many systems it can be ignored entirely. There are three segments of concern in the overall problem area, two of which are of primary interest to this discussion, and all three, of course, apply only to extra-terrestial or satellite vehicles. They are: orbital displacement of a satellite due to meteoroid impingement; induced torquing of a vehicle that may have some asymmetrical shape or form; and damage from impacts. Although the latter is not of direct concern for this study it is probably the most important of the three and will require considerable attention for long term satellites. The significance of the latter item is because of the probability of partial or total incapacitance of one or more elements of a control system by total destruction, puncture, or severe meteoric errosion. For example, loss of the control system could result from the accumulative effects of errosion on solar cells which provide power for the vehicle torquing or attitude control system.

The amount of data written on meteoroids indicates that the study of distribution, size and density of meteoroids has been a favorite area of research. Although there is an abundance of available material, there is little agreement among the various findings. In actuality it appears that accurate and high quality data will have to wait for more complete measurements by a variety of satellites. The first of the satellite data are beginning to be published, but there is little reliable information available for use in this report. Preliminary evaluations indicate that the estimated data will more or less bracket the actual.

The overall lack of satellite data on meteoroids is both surprising and in some respects disturbing. It is intuitive to look upon this as a basic area of investigation and one which would be more than adequately covered in the fourth year of artificial earth satellites. Although the 1958 Alpha, Gamma and Delta satellites were instrumented to record micrometeoroid impacts, the results of these measurements are of limited scope and usefulness. This can be attributed to a number of factors such as satellite component failures, the fact that the instrumentation and measuring surfaces were quite limited such that recorded impacts were limited to the micron range, and the rather limited scope of the program. It was suspected on the 1958 $\gamma$ that perhaps the whole micrometeoroid transmitter or instrumentation array may have been damaged by a sizable meteoroid on the second orbit since this coincided with one of the annual meteor showers. There have been more recent measurement on larger capsules, but the results of these measurements are not yet available.

It appears that meteoroid measurements were relegated to a secondary area of importance in most programs, because the pre-satellite investigations indicated that they would not be of primary concern to basic system safety or endurance. Also, for this reason, there has been little requirement to furnish more detailed information for programs such as Midas, Agena, or Mercury. Since the problem has been regarded as one of secondary significance there has not been the necessary emphasis to generate a system with enough

sophisticated instrumentation to measure a large segment of the meteoroid spectrum. The measuring problem is difficult because of the need for long measurement times, a wide range of measuring capability and large measuring areas.

It now appears that accurate size, weight, and velocity determinations for bodies much above micrometeoroid size, i.e., larger than one millimeter in diameter, will have to wait until widespread recovery of capsules permits actual counts to be made on the surface of the vehicles. This has been done with the first Russian manned satellites (1) but available data are incomplete. Unfortunately the recoveries on the Discoverer series have been of instrumentation and payload packages only. The Mercury program will be the first United States effort that will enable examination of sizable capsules after orbit. It must be stated however that the yield of useful data for particles over a fraction of a gram will still be very limited even with the direct measurements. Since the flux level of a meteor of this magnitude is so low, statistical data with any degree of reliability would have to be gathered by either a large number of satellites or by long exposure times. Because of the low flux levels of the sizable particles, an estimation based on ground observations may be the best available data for a number of years to come. For instance, the flux of a meteor of 1 gram mass striking the earth is estimated at approximately $10^6$ per day. It is evident from this that a sizable vehicle may stay in orbit many years without being struck by a particle of this order of magnitude.

## Methods of Estimation

Estimates of the flux levels of meteors have been made by Whipple (2, 3, 4), Pugh (6), Eichelberger (6), Huth (7), Bjork (6, 8) and others. Variations between the findings of these principle contributors and the estimates made by other individuals are off as much as two orders of magnitude. With respect to the estimates on micrometeors, the values vary as much as four orders of magnitude as shown in Figure 55 from Reference 5. There have been three primary methods of data collection: visual, photographic, and radar. Extensive research has been expended on the determination of meteor properties through correlation with the meteor trail and visual magnitude. Since the composition may vary from predominately stone to predominately iron, the velocity may vary from 36,000 ft/sec to over 230,000 ft/sec and the angle of incidences for interception of the earth's atmosphere also varies widely (5). The basic problem becomes one of significant proportions. Estimates of the mass of meteors as a function of visual magnitude have been made by comparing the total energy radiated to the kinetic energy which particles of various masses traveling at meteor speeds would have.

The smallest meteor that can be detected by the unaided eye is one which would have a visual magnitude of +6, which corresponds to a meteor diameter of approximately 0.04 inches and a mass of $1.1 \times 10^{-5}$ pounds, where magnitude (M) equals 2.5 log $(E_o/_E)$, $E_o = 1.944 \times 10^{-7}$ foot-candles, and

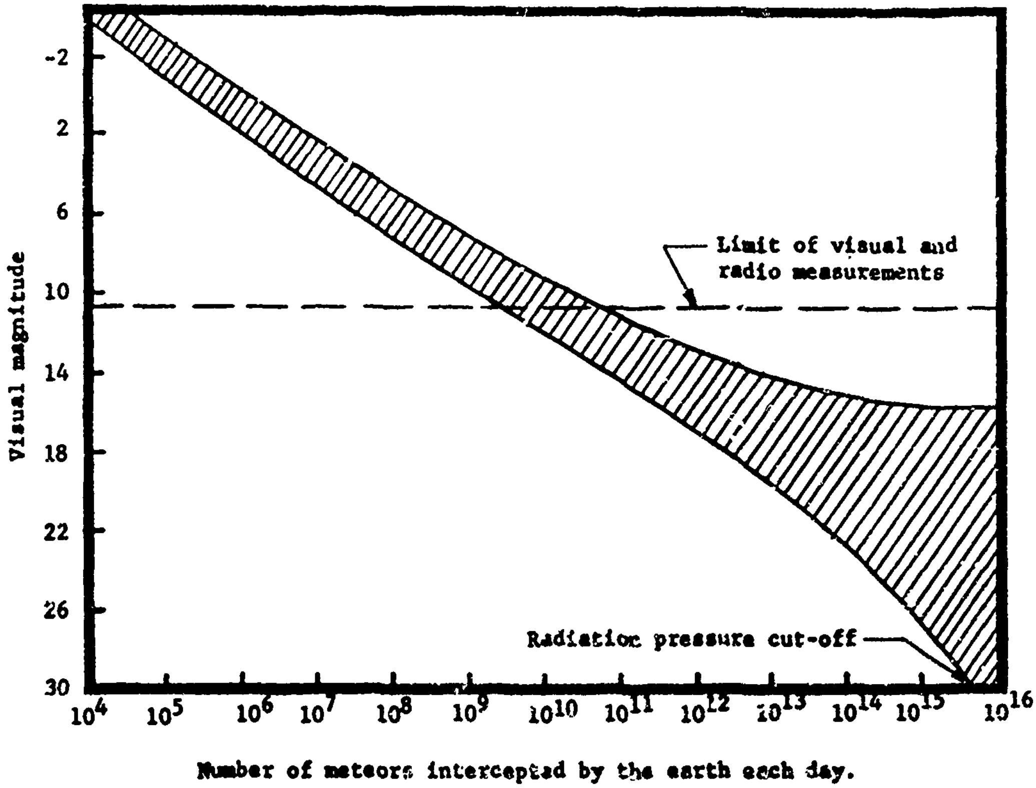


Figure 55. Distribution of Daily Meteor Influx

E is the observed illuminance. Visual magnitudes as small as +11 can be detected with meteor photography type telescopes, which reveal particles down to below $9\times10^{-3}$ inches in diameter and masses of slightly less than $1.52\times10^{-7}$ pounds. Radio means can detect signals returned from the ionized trail of meteors down to +10 magnitude. For meteors smaller than those that yield a +11 visual magnitude, extrapolation techniques must be used. Existing data for micrometeors are based on extrapolation, which for Whipple (4, 3) yields a mass decrease of 2.5 for each unit increase in magnitude. Other observers suggest mass decreases which vary slightly from Whipple's. Equivalent sizes above 30 magnitude have no meaning since solar pressure forces them out of the solar system.

Although the quantity of material available on meteoroids is voluminous, it is all somewhat hypothetical. In effect there are no empirical data available, as there have never been measurements to correlate visual magnitude with actual size, mass and velocity. A meteoroid of a size such that a portion of it reaches the earth is well down the scale of magnitudes in the range of -5 to -10. The probability of both measuring the visual magnitude and recovering the meteorite is slight. Therefore, the only inputs that approach direct measurements are those from satellities using piezo-electric sensors such as used on the Vanguard. These measurements were of particles in the size range equivalent to the +24 to +30 visual magnitude range ($10^{-10}$ grams). Even these measurements (3, 9, 10) are subject to considerable interpretation because of the number of variants to be considered. It is apparent that accurate and conclusive data on micrometeoroids will take a number of years to develop.

### Direction and Distribution

The problem of predicting the effect of meteoroids on artificial satellites is further compounded by the variability in both the direction and distribution of the particles. The results of measurements of micrometeoric paths indicate that most of the material is concentrated in streams or orbits which intersect the earth's orbit. Up to 90% of the impacts occur in specific 12 hour, annually-recurring periods (5). Variations in the day-to-day flux rate are as large as an order of magnitude. For the larger particles the variation of flux is probably even greater, as is evidenced by the thirty or so annually-recurring meteor showers which yield several orders of magnitude more visible meteors than the norm. It is not conclusive as to what degree of increase there is in the smaller particles in concurrence with these showers.

With respect to direction, excluding the earth and satellite velocity factors, the only generalized statement that can be made is that the earth and atmosphere shield a satellite such that the areas of impact are restricted essentially to those which are directed away or horizontal to the earth.

### Control and Orbital Displacement

The question of whether meteoroids and micrometeoroids can have an appreciable effect on the attitude or orbital position of a satellite has

received little attention. This is partially because of the number of indeterminates involved; but principally because it is generally considered as secondary when compared with the other sources of perturbations such as solar pressure, magnetic effects, and the oblateness of the earth. From consideration of the gross effect of collisions between meteoroids or micrometeoroids and the satellite, an equivalent long term pressure can be established.

By integrating the rate of change of momentum of all meteoroids, this equivalent pressure is found to be on the order of ten to the minus twelfth pounds per square inch. Actually such an equivalent pressure has no meaning on a short time basis, because of the low frequency of collision with any but the smaller micrometeoroids.

In many cases there will be very little transfer of momentum from the meteoroid since the collision will be such that the meteoroid passes completely through the satellite with small loss of energy. Estimated penetration depths can be determined from the following empirical expression (5) for stainless steel impacted by iron meteors.

$$T = (1.35 \ln V - 10.21) d$$

where

$V$ = meteor speed (ft/sec)

$d$ = meteor diameter (ft)

$T$ = penetration (ft)

Contained in Table 7, taken from Reference 5, is a listing of the diameters associated with the various visual magnitudes of daily meteors influx. Presented in Figure 56 (5) is a graph showing the distribution of speeds for two sets of meteor data--one set was measured photographically and the other using radio methods. Since the momentum of individual meteoroids is relatively large, those which do transfer momentum upon impact will produce significant force impulses. Such impulses will cause torques, depending upon the point on the satellite where the impact occurs, with the possible result of a significant attitude rate disturbance. A sample calculation based on a five-foot spherical satellite in a 300-mile orbit, with several plausible assumptions, indicates that an angular rate change as high as 0.003 degrees per second might result from the impact of a meteoroid with a visual magnitude of 10. This angular rate is approximately equal to the peak angular rate which the satellite might have in a steady state limit cycle. However, the probable rate of impact of this size meteoroid on the assumed satellite is in the order of one per hundred years.

The transfer of kinetic energy from a meteoroid to a satellite depends on the relative velocities of the satellite and the meteoroid. If the satellite is assumed to be stationary relative to the meteoroid, and it is assumed that all of the meteoroid's momentum is transferred to the satellite,

TABLE 7

| VISUAL MAGNITUDE | MASS | DIAMETER | | AVERAGE FLUX | KINETIC ENERGY |
|---|---|---|---|---|---|
| | | STONE | IRON | | |
| | lb. | ft. | ft. | $ft^{-2}day^{-1}$ | ft-lb |
| -3 | $4.4x10^{-2}$ | $7.3x10^{-2}$ | $5.5x10^{-2}$ | $5.1x10^{-12}$ | $1.2x10^{7}$ |
| -2 | $1.7x10^{-2}$ | $5.4x10^{-2}$ | $4.1x10^{-2}$ | $1.3x10^{-11}$ | $4.6x10^{6}$ |
| -1 | $6.8x10^{-3}$ | $3.9x10^{-2}$ | $2.9x10^{-2}$ | $3.3x10^{-11}$ | $1.8x10^{6}$ |
| 0 | $2.6x10^{-3}$ | $2.9x10^{-2}$ | $2.2x10^{-2}$ | $8.2x10^{-11}$ | $7.1x10^{5}$ |
| 1 | $1.1x10^{-3}$ | $2.1x10^{-2}$ | $1.6x10^{-2}$ | $2.0x10^{-10}$ | $2.9x10^{5}$ |
| 2 | $4.4x10^{-4}$ | $1.6x10^{-2}$ | $1.2x10^{-2}$ | $5.1x10^{-10}$ | $1.2x10^{5}$ |
| 3 | $4.4x10^{-4}$ | $1.2x10^{-2}$ | $9.0x10^{-3}$ | $1.3x10^{-9}$ | $4.6x10^{4}$ |
| 4 | $6.8x10^{-5}$ | $8.5x10^{-3}$ | $6.4x10^{-3}$ | $3.3x10^{-9}$ | $1.8x10^{4}$ |
| 5 | $2.6x10^{-5}$ | $6.2x10^{-3}$ | $4.7x10^{-3}$ | $8.2x10^{-9}$ | $7.1x10^{3}$ |
| 6 | $1.1x10^{-5}$ | $4.6x10^{-3}$ | $3.5x10^{-3}$ | $2.0x10^{-8}$ | $2.9x10^{3}$ |
| 7 | $4.4x10^{-6}$ | $3.4x10^{-3}$ | $2.6x10^{-3}$ | $5.1x10^{-8}$ | $1.2x10^{3}$ |
| 8 | $1.7x10^{-6}$ | $2.5x10^{-3}$ | $1.9x10^{-3}$ | $1.3x10^{-7}$ | $4.6x10^{2}$ |
| 9 | $6.8x10^{-7}$ | $1.8x10^{-3}$ | $1.4x10^{-3}$ | $3.3x10^{-7}$ | $1.8x10^{2}$ |
| 10 | $2.6x10^{-7}$ | $1.3x10^{-3}$ | $9.8x10^{-4}$ | $8.2x10^{-7}$ | $7.1x10^{1}$ |
| | | -EXTRAPOLATED- | | | |
| 12 | $4.4x10^{-8}$ | $7.3x10^{-4}$ | $5.5x10^{-4}$ | $5.1x10^{-6}$ | $1.2x10^{1}$ |
| 15 | $2.6x10^{-9}$ | $2.9x10^{-4}$ | $2.2x10^{-4}$ | $8.2x10^{-5}$ | $7.1x10^{-1}$ |
| 20 | $2.6x10^{-11}$ | $6.2x10^{-5}$ | $4.7x10^{-5}$ | $8.2x10^{-3}$ | $7.1x10^{-3}$ |
| 25 | $2.6x10^{-13}$ | $1.3x10^{-5}$ | $9.8x10^{-6}$ | $8.2x10^{-1}$ | $7.1x10^{-5}$ |
| 30 | $2.6x10^{-15}$ | $2.9x10^{-6}$ | $2.2x10^{-6}$ | $8.2x10^{1}$ | $7.1x10^{-7}$ |

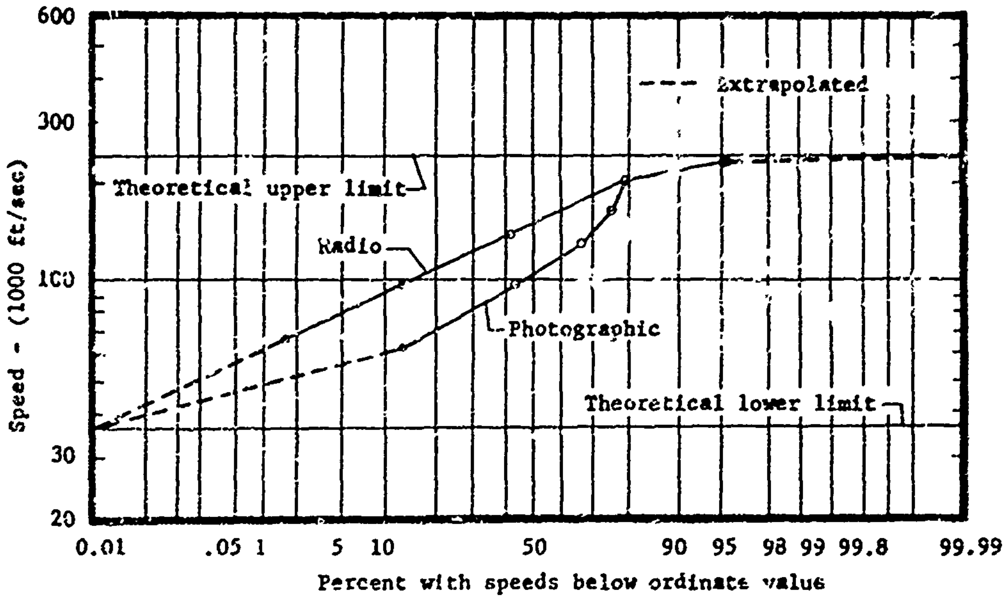


Figure 56. Distribution of Geocentric Meteor Speeds

the kinetic energy increase of the satellite is equal to the initial kinetic energy of the meteoroid times the ratio of meteoroid to satellite masses. As previously indicated the division between translational and rotational motion resulting from a kinetic energy change is largely a matter of conjecture. It takes a large number of assumptions to get numerical values in the meteor-control system area.

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## SENSOR NOISE

The term sensor noise, as used here, refers to noise signals which cause erratic system operation; and also to noise signals which reduce the fidelity of performance of a flight control system. Specific data regarding the occurrence or intensity of sensor noise can not be given in a manner such as used in describing winds, for example, because they are predominantly influenced by the design of the vehicle and control system in question. For this reason, the information given in this subsection simply describes the major sources of sensor noise due to environmental and general design factors. Environmental factors which lead to sensor noise include electromagnetic fields, electrostatic fields, magnetic fields, vibration and even gravitation fields.

As an example of the influence of the electromagnetic field, consider a system utilizing a very-high-frequency (VHF) receiver through which control information is transmitted to a vehicle. The receiver may reject high-frequency signals that are 100 db greater at the antenna terminals than is the minimum receivable VHF signal. However, if a powerful high-frequency transmitter is energized in the vicinity, the interference may be sufficiently great to saturate or block the receiver through action of its automatic gain control. Harmonics or other transmitted frequencies might fall directly within the normal pass band of the receiver and thereby produce spurious signals.

An effect associated with electrostatic fields is the generation of a "plasma" sheath of ions and free electrons in connection with the shock wave of a vehicle traveling at hypersonic speeds within the atmosphere (1). The resulting severe reflection and attenuation of electromagnetic waves can produce "radio blackout" and consequent interruption of radio guidance information. F. J. Tischer (2) indicates that systems utilizing doppler shift as an information source can be disturbed by "variations of the wave-propagation properties along the transmission path." He points out, as examples of possible disturbing influences, that variations "may occur because of ionization by meteors in the upper atmosphere or radiation burst in from space." He also states, ".... an observer flying through an electron cloud may observe a deviation of the doppler shift because of the influence of the cloud, depending on the electron density at his position. Varying air density in the upper atmosphere has a similar effect."

A vehicle's guidance system that depends upon radio reception can also have its operation drastically impaired by corona discharge which becomes evident in the form of "precipitation-static" interference (3). Corona may be produced when a vehicle flies through electric fields, as may exist between a cloud and ground; or when it is exposed to impingement of chargeable particles, such as dry snow, ice crystals, or dust. In such an atmosphere the corona may become so severe that operation of a given electronic facility on the vehicle is completely disrupted. In a phenomenon similar to precipitation-static charging, high-velocity exhaust particles from a propulsion engine may acquire an electrical charge in the engine, leaving an opposite charge on the vehicle.

Magnetic field variations can cause noise signals to be induced in conductors in various ways. Mechanical vibration of wires in a "fixed" field will cause induced voltages at the vibration frequency. Vibration of the rotor of a synchro, for example, will cause an induced voltage variation at its output. Operating in a zero gravity environment, a rotor will be motivated to a greater degree when subjected to vibration; because of the lack of a force bias resulting from its weight.

One noise source which can influence signal circuits by electromagnetic radiation and conducted interference is the fluorescent lamp. The lamp itself, being a gas discharge tube, produces white noise (4) over a wide frequency spectrum. Additionally, the ballast, operated in conjunction with the non-linearity of the lamp discharge, has both current and flux waveforms that are by no means sinusoidal (5). Interference over a wide frequency range is thus produced, posing a serious threat to sensor equipment operating at carrier frequencies well above the frequency band associated with flight control system response.

Before a control system is designed or built, the noise generated within the sensors to be used may be ascertained from the sensor manufacturer or from tests; however, the circuit and mechanical arrangement in which they are used will greatly influence the actual noise level experienced. Components such as synchros or tachometers have voltage variations (slot effect) synchronized with the angular position of their shaft (6). When connected in a control system, they may exhibit an additional voltage variation due to irregularities in the associated gearing.

High frequency standing waves on vehicle structure or other conductors, such as racks and cables, can arise because of electrical coupling to high-frequency energy sources. "Hot spots" which may result can cause significant impedance changes within the system. Rectification of the high-frequency energy can occur wherever it passes through an electrical non-linearity, such as a junction of dissimilar metals, with the resulting direct current voltages producing bias signals in control circuits. Other potential differences between various points on the vehicle structure can result from ground currents which may either directly or indirectly cause off-setting signals.

Interaction between the flight control system and other systems on the vehicle can frequently cause erratic operation of the control system and may therefore be considered as noise sources. The "prop modulation" of radio signals on propeller or rotary wing vehicles can equal or exceed the intentional modulation in some cases. Unsynchronized alternating current generators will produce beat frequencies which can cause hunting in various control system circuits. The major interaction, however, is frequently found between the control system and the properly operating power sources which it uses. Voltage and frequency variations of the electrical supply, resulting from the dynamic response characteristics of its voltage and frequency regulators, may couple with the dynamic characteristics of the flight control system and thereby drastically affect its operation. It is also possible for a similar coupling to result from the interaction of the pressure or flow control of a hydraulic power source and the dynamic characteristics of a system utilizing a hydraulic actuator.

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## IV DATA SOURCES

Numerous programs producing data which will supplement those given in Section III are either planned, in progress, or recently completed but not yet reported. The purpose of this section is to identify such programs so that the information can be acquired and utilized when it becomes available. There are some areas of stochastic disturbances where little or no effort has been made to gather data and no information on planned programs can be found. Recommendations concerning these areas are made in Section V of this report.

### WINDS AND WIND SHEAR

High altitude wind measurements are currently being made in Australia by that government's Weapons Research Establishment and the University College, London. The measurements are being made under twilight conditions, using the smoke grenade technique. Particular attention is being paid to the 250,000 to 400,000 foot altitude range which will provide data in the gap between the altitudes where the light and sound techniques and the glowcloud technique are utilized, with an overlap in each case. Actually any valid wind data from this region are useful since southern hemisphere wind data are rather sparce.

Wind speed studies are being conducted in England under the auspices of the University College, London and the British Meteorological Office, and independent wind and density measurements are being made by the University of Belfast. The methods used in obtaining these data are the tracking of sodium clouds and the luminous glows which follow grenade bursts above 300,000 feet. Results of this work can be used in evaluating the validity of the general theory of uniform global wind conditions in the 300,000 foot altitude range.

It is also planned by the British Meteorological Office to use small rockets launched from sites in the British Isles to raise the present radiosonde ceiling of 100,000 feet first to 200,000 feet, and later to 300,000 feet. Design studies for suitable rockets are complete. (This will be a natural extension of balloon soundings.)

NASA is conducting tests with sodium-vapor trails, released at numerous altitudes between 240,000 feet and 2,300,000 feet. Lithium vapor is also being used in the 2,000,000 feet range. The purpose of these tests is to measure atmospheric winds, turbulence, density, and diffusion effects. Results have shown intense winds and turbulence up to altitudes of 320,000 feet. All launchings in this program are being made from Wallops Island, Virginia.

## GUSTS

There are no known plans for future work in the area of gust measurements. It is felt, however, that a careful examination of the results of the recent Douglas study, given as Reference 33 in the gust subsection of Section III, may reveal more detailed information directly usable in flight control system analysis.

## THRUST IRREGULARITIES

Basic data from which power spectra of thrust variations and engine to engine differences may be obtained from Aro, Inc. at the Arnold Air Force Station. Similar basic data may be obtained from the various manufacturers of solid and liquid propellant engines.

Limited work in the area of thrust vector drift measurement is being done at the Lewis Research and Goddard Space Flight Centers of NASA. Investigations of the characteristics and irregularities of reaction control rockets and "microjets" are also being carried out at these same two organizations.

## ACOUSTICAL VIBRATION

Programs to gather acoustical vibration data from missile flights are active at the Lockheed Missile and Space Company, Convair Division of General Dynamics Corporation, and Douglas Aircraft Company. Generally, these programs are given a low priority and their required instrumentation and telemetry channels are among the first to be eliminated when a firing plan is frozen. As a consequence, the present extent and validity of such data are wanting.

## MAGNETIC FIELDS

A program is scheduled by NASA and the University of Michigan to launch two Javelin rockets from Fort Churchill, Canada, and two from Wallops Island, Virginia, for the purpose of measuring magnetic fields. A program to use a Skylark carrying a proton precession magnetometer for magnetic field measurements is also planned by the Geophysics Department of the Imperial College in London. Correlation of the results of these programs with the results given in the magnetic field portion of Section III would be useful.

## SOLAR RADIATION

Extensive studies have been made in Germany by H. K. Paetzold, Fr. Becker and W. Priester on the effects of solar radiation on atmospheric densities. A model of atmospheric densities from 400,000 to

5,000,000 feet altitude has been compiled relating the solar activity, diurnal, and semiannual effects of radiation as determined from various satellite tracking programs. References to some of the recent published works resulting from these studies are included in the Bibliography Section.

METEORS

The Queen's University of Belfast, England is making micrometeorite studies by using microphone type detectors in Skylark rockets. These operate successfully in flight and impact records have been obtained. Other micrometeorite studies using the same rocket, but employing a different measuring technique, are in progress at the Jodrell Bank Station of Manchester University. The technique consists of exposing thin sheets of aluminum foil to impacting particles which form holes upon impact. The holes are scanned by sunlight and transmit light pulses which are detected by silicon cells. Calibrated holes allow an estimate to be made of the size of the micrometeorite thus detected. A form of this instrumentation suitable for installation in satellites is being developed.

Micrometeorite instrumentation, included as part of the payload in 1960 Xi (Explorer VIII), included one detector which consisted of two microphones with a maximum detectable sensitivity of $10^{-4}$ dyne-seconds and a dynamic range of three decades, and a second detector consisting of a photo-multiplier tube with a 1,000-A evaporated layer of aluminum on the window. Light flashes generated by micrometeorite impacts in the aluminum are translated into pulses of varying length and amplitude by the photo-multiplier. The pulses are then interpreted in terms of the kinetic energy of the impinging particle. Results of this program, which was under the direction of NASA, should be available in the near future.

The 1960 Zeta (Midas II), launched by the Air Force in May 1960, carried acoustic micrometeorite detectors for particles larger than 6 microns. Preliminary analysis of data received from the satellite indicated impact rates larger by a factor of 3 to 10 than previously measured.

NASA is planning a micrometeorite satellite for launch in the near future. This satellite will be instrumented to obtain a direct measure of the micrometeorite puncture hazard to structural skin samples by measuring micrometeorites having momenta in the range of $10^{-4}$ gram centimeters per second or larger. Five types of detectors will be used including pressurized cells, foil gages, wire grids, cadmium sulfide photocells, and piezoelectric microphone detectors. The satellite will also carry silicon solar cells for evaluation of erosive and other adverse effects of the space environment. The shape of this satellite is cylindrical, about 24 inches in diameter and 77 inches long, allowing a measuring area in excess of 23 square feet.

## SENSOR NOISE

No general study programs are known which cover sensor noise. Noise information can undoubtedly be obtained for specific sensors from their manufacturers, but sensor noise related to applicable circuits and environments could be obtained only from an extensive compilation of data from many subsystem and system designers.

An excellent collection of references in one field of interest is found in a special bibliography of the Lockheed Missile and Space Company entitled, "Effects of Electromagnetic Fields upon Instrumentation Components and Systems," SB-60-27, July 1960, by George R. Evans.

## V RECOMMENDATIONS

A careful review of the many programs supplying data for this report clearly indicates a lack of appreciation on the part of the originators and investigators for the application of their findings to the flight controls systems. It is recommended therefore, that the project engineer assigned to this program promulgate and stress the importance of stochastic disturbance data to control system analysis by means of correspondence, publication of articles in "popular" technical magazines or other media. The improved usefulness in the form of data reporting which might result would be highly beneficial. It is also possible that this orientation would encourage the slight increase in effort required to obtain data useful in control system analysis in programs primarily directed towards other basic objectives.

It is recommended that some effort be made to have this report revised from time to time so that the information will be current and complete. When more extensive low altitude wind and wind shear data are gathered from balloon soundings, using the rawin-2 system for example, the results presented here should be modified if such is indicated.

Due to the importance of thrust irregularity disturbances and the present lack of data in this field, it is recommended that a specific program be initiated to obtain vector drift statistics and power spectral densities of thrust variations for the more important main propulsion missile engines. Data on thrust irregularities of reaction control motors should also be included as a part of such a program.

The interface problem involved in the manner in which both stochastic and non-stochastic disturbances are applied to the analysis of a flight control system is an area worthy of study. The importance of selecting the proper period of a one minus cosine gust impulse, discussed briefly in this report, is a prime example. Another would be the establishment of relations between the thrust build-up and decay times and the ultimate attitude resolution obtainable in a "bang-bang" type reaction control system. It is recommended that application problems of this nature be formulated and a program for their analysis carried out.

## VI BIBLIOGRAPHY

In the Disturbance Section of this report, each disturbance subsection contained its own related references. The references were provided to indicate the direct sources from which the information was extracted.

Other useful information reviewed in conjunction with the literature research on the various disturbances are included in the following bibliography with references covering several subjects listed according to their subject of greatest application.


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APPENDIX I

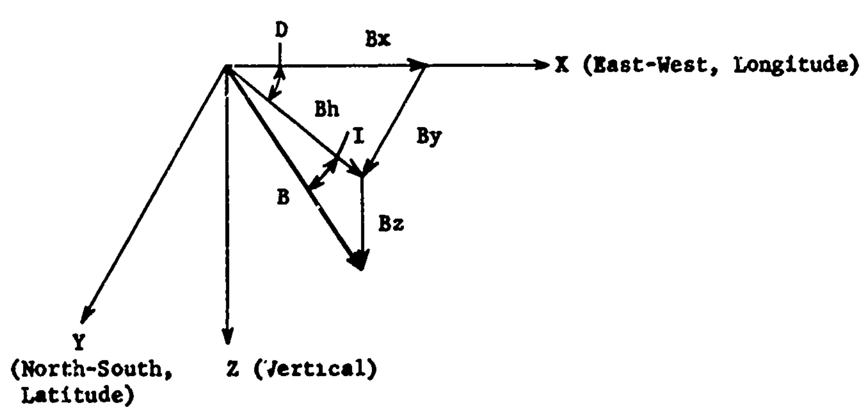
TABLE OF EARTH MAGNETIC FIELD INTENSITIES

The table of magnetic field intensities presented in this report is included not because magnetic field intensities are considered as stochastic, but because a detailed table of field intensities in the area of satellite orbiting is not readily available.

One computer program for the solution of the magnetic field intensity equations (Magnetic Fields) is maintained by the Air Force at Kirtland AFB, New Mexico and is available in several forms including a 704 Fortran and a ALGOL subroutine. Capt. J. A. Welch and Mr. R. W. Murray of the Air Force Special Weapons Center, Physics Division, Kirtland AFB, maintain the program. The following table of magnetic field intensities is the result of a computer run by Lockheed's Georgia Company using this basic program, but modified for use on the 7090. The 7090 program is available on request from the Lockheed-Georgia Company.

The table of magnetic field intensity is given for the various latitudes, longitudes and altitudes up to 1,000 miles from the earth's surface. The increments of field location were made relatively small to afford interpolation for intermediate values that may be required. Because of the vast amount of input from geomagnetic surveys, including satellite measurements, the computer program yields data that are within 1% accuracy. This, of course, does not take into consideration local anomalies but does include the regional anomalies. The tabulation presents altitude (H) in feet, latitude (theta) and Longitude (phi) in degrees, the total intensity (B), and the X (Bx), Y (By) and Z (Bz) components in the units of oersteds.

The vector relationship of the various components are illustrated in the following diagram:



where:

$X$ = Horizontal east-west direction.

$Y$ = Horizontal north-south direction.

$Z$ = Vertical (to earth) direction.

$B$ = Total magnetic field intensity.

$B_h$ = Horizontal component of magnetic field intensity.

$B_x$ = Horizontal east-west component of magnetic field intensity.

$B_y$ = Horizontal north-south component of magnetic field intensity.

$B_z$ = Vertical component of magnetic field intensity, positive downward.

$I$ = Magnetic inclination; the angle between $B_h$ and $B$; the angle by which a freely privoted magnetic needle dips below the horizontal. Positive when the north pole of the needle points down.

$D$ = Declination: the angle between $B_h$ and $X$; the angle between the geographical north and the magnetic north. Positive when the magnetic north is east of the geographical north.

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 0. | -90.00 | 0. | 0.5633 | -0.5432 | 0 | 0 |
| 0. | -80.00 | 0. | 0.5252 | -0.4988 | 0.1439 | 0.0793 |
| 0. | -80.00 | 15.0000 | 0.5322 | -0.5086 | 0.1204 | 0.0999 |
| 0. | -80.00 | 30.0000 | 0.5383 | -0.5183 | 0.0926 | 0.1123 |
| 0. | -80.00 | 45.0000 | 0.5429 | -0.5259 | 0.0647 | 0.1183 |
| 0. | -80.00 | 60.0000 | 0.5476 | -0.5325 | 0.0371 | 0.1222 |
| 0. | -80.00 | 75.0000 | 0.5552 | -0.5412 | 0.0072 | 0.1237 |
| 0. | -80.00 | 90.0000 | 0.5659 | -0.5529 | -0.0241 | 0.1183 |
| 0. | -80.00 | 105.0000 | 0.5791 | -0.5671 | -0.0514 | 0.1054 |
| 0. | -80.00 | 120.0000 | 0.5969 | -0.5859 | -0.0726 | 0.0881 |
| 0. | -80.00 | 135.0000 | 0.6218 | -0.6117 | -0.0909 | 0.0652 |
| 0. | -80.00 | 150.0000 | 0.6497 | -0.6401 | -0.1076 | 0.0284 |
| 0. | -80.00 | 165.0000 | 0.6685 | -0.6578 | -0.1163 | -0.0270 |
| 0. | -80.00 | 180.0000 | 0.6668 | -0.6518 | -0.1068 | -0.0914 |
| 0. | -80. | 195.0000 | 0.6426 | -0.6213 | -0.0765 | -0.1450 |
| 0. | -80.00 | 210.0000 | 0.6044 | -0.5780 | -0.0327 | -0.1736 |
| 0. | -80.00 | 225.0000 | 0.5656 | -0.5373 | 0.0145 | -0.1760 |
| 0. | -80.00 | 240.0000 | 0.5361 | -0.5082 | 0.0580 | -0.1604 |
| 0. | -80.00 | 255.0000 | 0.5185 | -0.4912 | 0.0953 | -0.1359 |
| 0. | -80.00 | 270.0000 | 0.5096 | -0.4820 | 0.1262 | -0.1070 |
| 0. | -80.00 | 285.0000 | 0.5058 | -0.4775 | 0.1494 | -0.0742 |
| 0. | -80.00 | 300.0000 | 0.5058 | -0.4772 | 0.1631 | -0.0398 |
| 0. | -80.00 | 315.0000 | 0.5088 | -0.4801 | 0.1683 | -0.0070 |
| 0. | -80.00 | 330.0000 | 0.5133 | -0.4847 | 0.1672 | 0.0235 |
| 0. | -80.00 | 345.0000 | 0.5188 | -0.4908 | 0.1596 | 0.0527 |
| 0. | 70.00 | 0. | 0.4516 | -0.4079 | 0.1784 | 0.0753 |
| 0. | -70.00 | 15.0000 | 0.4719 | -0.4313 | 0.1621 | 0.1018 |
| 0. | -70.00 | 30.0000 | 0.5016 | -0.4681 | 0.1382 | 0.1159 |
| 0. | -70.00 | 45.0000 | 0.5181 | -0.4941 | 0.1099 | 0.1104 |
| 0. | -70.00 | 60.0000 | 0.5199 | -0.5004 | 0.0861 | 0.1118 |
| 0. | -70.00 | 75.0000 | 0.5431 | -0.5237 | 0.0589 | 0.1310 |
| 0. | -70.00 | 90.0000 | 0.5920 | -0.5763 | 0.0227 | 0.1334 |
| 0. | -70.00 | 105.0000 | 0.6312 | -0.6225 | -0.0119 | 0.1033 |
| 0. | -70.00 | 120.0000 | 0.6438 | -0.6400 | -0.0314 | 0.0619 |
| 0. | -70.00 | 135.0000 | 0.6440 | -0.6424 | -0.0299 | 0.0339 |
| 0. | -70.00 | 150.0000 | 0.6609 | -0.6604 | -0.0190 | 0.0196 |
| 0. | -70.00 | 165.0000 | 0.6980 | -0.6978 | -0.0119 | -0.0144 |
| 0. | -70.00 | 180.0000 | 0.7152 | -0.7111 | 0.0031 | -0.0764 |
| 0. | -70.00 | 195.0000 | 0.6963 | -0.6847 | 0.0264 | -0.1239 |
| 0. | -70.00 | 210.0000 | 0.6599 | -0.6417 | 0.0436 | -0.1475 |
| 0. | -70.00 | 225.0000 | 0.6119 | -0.5880 | 0.0601 | -0.1581 |
| 0. | -70.00 | 240.0000 | 0.5600 | -0.5319 | 0.0838 | -0.1541 |
| 0. | -70.00 | 255.0000 | 0.5182 | -0.4856 | 0.1147 | -0.1400 |
| 0. | -70.00 | 270.0000 | 0.4852 | -0.4465 | 0.1492 | -0.1176 |
| 0. | -70.00 | 285.0000 | 0.4627 | -0.4191 | 0.1796 | -0.0788 |
| 0. | -70.00 | 300.0000 | 0.4610 | -0.4157 | 0.1959 | -0.0362 |
| 0. | -70.00 | 315.0000 | 0.4645 | -0.4186 | 0.2013 | -0.0093 |
| 0. | -70.00 | 330.0000 | 0.4561 | -0.4092 | 0.2010 | 0.0136 |
| 0. | -70.00 | 345.0000 | 0.4471 | -0.4009 | 0.1928 | 0.0444 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 0. | -60.00 | 0. | 0.3825 | -0.3385 | 0.1628 | 0.0723 |
| 0. | -60.00 | 15.0000 | 0.3903 | -0.3511 | 0.1498 | 0.0815 |
| 0. | -60.00 | 30.0000 | 0.4147 | -0.3756 | 0.1455 | 0.0995 |
| 0. | -60.00 | 45.0000 | 0.4538 | -0.4184 | 0.1369 | 0.1099 |
| 0. | -60.00 | 60.0000 | 0.4837 | -0.4568 | 0.1134 | 0.1115 |
| 0. | -60.00 | 75.0000 | 0.5168 | -0.4944 | 0.0920 | 0.1192 |
| 0. | -60.00 | 90.0000 | 0.5621 | -0.5436 | 0.0821 | 0.1169 |
| 0. | -60.00 | 105.0000 | 0.6106 | -0.5980 | 0.0708 | 0.1013 |
| 0. | -60.00 | 120.0000 | 0.6490 | -0.6436 | 0.0565 | 0.0615 |
| 0. | -60.00 | 135.0000 | 0.6689 | -0.6668 | 0.0481 | 0.0236 |
| 0. | -60.00 | 150.0000 | 0.6845 | -0.6819 | 0.0588 | -0.0033 |
| 0. | -60.00 | 165.0000 | 0.7189 | -0.7131 | 0.0844 | -0.0348 |
| 0. | -60.00 | 180.0000 | 0.7076 | -0.6906 | 0.1163 | -0.1013 |
| 0. | -60.00 | 195.0000 | 0.6462 | -0.6176 | 0.1445 | -0.1237 |
| 0. | -60.00 | 210.0000 | 0.6021 | -0.5664 | 0.1658 | -0.1197 |
| 0. | -60.00 | 225.0000 | 0.5743 | -0.5370 | 0.1713 | -0.1100 |
| 0. | -60.00 | 240.0000 | 0.5532 | -0.5153 | 0.1639 | -0.1168 |
| 0. | -60.00 | 255.0000 | 0.5149 | -0.4685 | 0.1722 | -0.1264 |
| 0. | -60.00 | 270.0000 | 0.4687 | -0.4124 | 0.1892 | -0.1173 |
| 0. | -60.00 | 285.0000 | 0.4236 | -0.3572 | 0.2100 | -0.0881 |
| 0. | -60.00 | 300.0000 | 0.3963 | -0.3239 | 0.2277 | -0.0431 |
| 0. | -60.00 | 315.0000 | 0.3835 | -0.3084 | 0.2280 | -0.0012 |
| 0. | -60.00 | 330.0000 | 0.3728 | -0.3088 | 0.2064 | 0.0315 |
| 0. | -60.00 | 345.0000 | 0.3711 | -0.3177 | 0.1832 | 0.0570 |
| 0. | -50.00 | 0. | 0.3285 | -0.2852 | 0.1459 | 0.0727 |
| 0. | -50.00 | 15.0000 | 0.3487 | -0.3127 | 0.1338 | 0.0766 |
| 0. | -50.00 | 30.0000 | 0.3735 | -0.3410 | 0.1312 | 0.0774 |
| 0. | -50.00 | 45.0000 | 0.3991 | -0.3651 | 0.1334 | 0.0902 |
| 0. | -50.00 | 60.0000 | 0.4385 | -0.4057 | 0.1308 | 0.1029 |
| 0. | -50.00 | 75.0000 | 0.4862 | -0.4592 | 0.1147 | 0.1113 |
| 0. | -50.00 | 90.0000 | 0.5323 | -0.5132 | 0.0983 | 0.1020 |
| 0. | -50.00 | 105.0000 | 0.5902 | -0.5758 | 0.0937 | 0.0892 |
| 0. | -50.00 | 120.0000 | 0.6343 | -0.6244 | 0.1028 | 0.0428 |
| 0. | -50.00 | 135.0000 | 0.6572 | -0.6460 | 0.1206 | 0.0070 |
| 0. | -50.00 | 150.0000 | 0.6456 | -0.6261 | 0.1516 | -0.0420 |
| 0. | -50.00 | 165.0000 | 0.6351 | -0.6066 | 0.1799 | -0.0548 |
| 0. | -50.00 | 180.0000 | 0.6141 | -0.5768 | 0.1913 | -0.0884 |
| 0. | -50.00 | 195.0000 | 0.5815 | -0.5405 | 0.1894 | -0.1005 |
| 0. | -50.00 | 210.0000 | 0.5357 | -0.4908 | 0.1873 | -0.1046 |
| 0. | -50.00 | 225.0000 | 0.5014 | -0.4532 | 0.1938 | -0.0918 |
| 0. | -50.00 | 240.0000 | 0.4921 | -0.4359 | 0.2076 | -0.0956 |
| 0. | -50.00 | 255.0000 | 0.4589 | -0.3914 | 0.2130 | -0.1098 |
| 0. | -50.00 | 270.0000 | 0.4142 | -0.3335 | 0.2221 | -0.1048 |
| 0. | -50.00 | 285.0000 | 0.3654 | -0.2698 | 0.2321 | -0.0827 |
| 0. | -50.00 | 300.0000 | 0.3266 | -0.2294 | 0.2305 | -0.0308 |
| 0. | -50.00 | 315.0000 | 0.3089 | -0.2247 | 0.2111 | 0.0190 |
| 0. | -50.00 | 330.0000 | 0.3121 | -0.2437 | 0.1888 | 0.0490 |
| 0. | -50.00 | 345.0000 | 0.3146 | -0.2608 | 0.1632 | 0.0659 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 0. | -40.00 | 0. | 0.2994 | -0.2607 | 0.1283 | 0.0725 |
| 0. | -40.00 | 15.0000 | 0.3246 | -0.2918 | 0.1282 | 0.0616 |
| 0. | -40.00 | 30.0000 | 0.3352 | -0.3000 | 0.1361 | 0.0623 |
| 0. | -40.00 | 45.0000 | 0.3640 | -0.3291 | 0.1364 | 0.0747 |
| 0. | -40.00 | 60.0000 | 0.4066 | -0.3694 | 0.1444 | 0.0895 |
| 0. | -40.00 | 75.0000 | 0.4723 | -0.4368 | 0.1480 | 0.1017 |
| 0. | -40.00 | 90.0000 | 0.5342 | -0.5047 | 0.1498 | 0.0909 |
| 0. | -40.00 | 105.0000 | 0.5825 | -0.5567 | 0.1598 | 0.0619 |
| 0. | -40.00 | 120.0000 | 0.6152 | -0.5894 | 0.1746 | 0.0240 |
| 0. | -40.00 | 135.0000 | 0.6277 | -0.5969 | 0.1939 | -0.0112 |
| 0. | -40.00 | 150.0000 | 0.6066 | -0.5711 | 0.1990 | -0.0471 |
| 0. | -40.00 | 165.0000 | 0.5928 | -0.5510 | 0.2098 | -0.0616 |
| 0. | -40.00 | 180.0000 | 0.5646 | -0.5107 | 0.2254 | -0.0850 |
| 0. | -40.00 | 195.0000 | 0.5196 | -0.4534 | 0.2375 | -0.0893 |
| 0. | -40.00 | 210.0000 | 0.4955 | -0.4293 | 0.2337 | -0.0813 |
| 0. | -40.00 | 225.0000 | 0.4710 | -0.3979 | 0.2371 | -0.0857 |
| 0. | -40.00 | 240.0000 | 0.4431 | -0.3607 | 0.2422 | -0.0871 |
| 0. | -40.00 | 255.0000 | 0.4103 | -0.3180 | 0.2420 | -0.0933 |
| 0. | -40.00 | 270.0000 | 0.3633 | -0.2590 | 0.2379 | -0.0913 |
| 0. | -40.00 | 285.0000 | 0.3105 | -0.1978 | 0.2295 | -0.0679 |
| 0. | -40.00 | 300.0000 | 0.2708 | -0.1578 | 0.2194 | -0.0162 |
| 0. | -40.00 | 315.0000 | 0.2633 | -0.1624 | 0.2045 | 0.0335 |
| 0. | -40.00 | 330.0000 | 0.2690 | -0.1898 | 0.1785 | 0.0668 |
| 0. | -40.00 | 345.0000 | 0.2836 | -0.2302 | 0.1464 | 0.0775 |
| 0. | -30.00 | 0. | 0.3021 | -0.2654 | 0.1258 | 0.0709 |
| 0. | -30.00 | 15.0000 | 0.3055 | -0.2732 | 0.1291 | 0.0453 |
| 0. | -30.00 | 30.0000 | 0.3218 | -0.2867 | 0.1343 | 0.0574 |
| 0. | -30.00 | 45.0000 | 0.3551 | -0.3172 | 0.1513 | 0.0508 |
| 0. | -30.00 | 60.0000 | 0.3865 | -0.3400 | 0.1695 | 0.0714 |
| 0. | -30.00 | 75.0000 | 0.4444 | -0.3941 | 0.1880 | 0.0827 |
| 0. | -30.00 | 90.0000 | 0.5034 | -0.4558 | 0.2021 | 0.0693 |
| 0. | -30.00 | 105.0000 | 0.5502 | -0.5018 | 0.2212 | 0.0447 |
| 0. | -30.00 | 120.0000 | 0.5767 | -0.5189 | 0.2516 | 0.0005 |
| 0. | -30.00 | 135.0000 | 0.5713 | -0.5015 | 0.2729 | -0.0215 |
| 0. | -30.00 | 150.0000 | 0.5651 | -0.4887 | 0.2802 | -0.0443 |
| 0. | -30.00 | 165.0000 | 0.5419 | -0.4537 | 0.2891 | -0.0650 |
| 0. | -30.00 | 180.0000 | 0.5078 | -0.4104 | 0.2893 | -0.0756 |
| 0. | -30.00 | 195.0000 | 0.4711 | -0.3740 | 0.2760 | -0.0765 |
| 0. | -30.00 | 210.0000 | 0.4485 | -0.3386 | 0.2833 | -0.0769 |
| 0. | -30.00 | 225.0000 | 0.4162 | -0.2990 | 0.2797 | -0.0748 |
| 0. | -30.00 | 240.0000 | 0.3874 | -0.2686 | 0.2694 | -0.0738 |
| 0. | -30.00 | 255.0000 | 0.3600 | -0.2357 | 0.2608 | -0.0776 |
| 0. | -30.00 | 270.0000 | 0.3230 | -0.1850 | 0.2539 | -0.0751 |
| 0. | -30.00 | 285.0000 | 0.2831 | -0.1342 | 0.2440 | -0.0512 |
| 0. | -30.00 | 300.0000 | 0.2509 | -0.1054 | 0.2277 | -0.0014 |
| 0. | -30.00 | 315.0000 | 0.2407 | -0.1205 | 0.2029 | 0.0477 |
| 0. | -30.00 | 330.0000 | 0.2521 | -0.1612 | 0.1749 | 0.0834 |
| 0. | -30.00 | 345.0000 | 0.2817 | -0.2223 | 0.1484 | 0.0889 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 0. | -20.00 | 0. | 0.3207 | -0.2633 | 0.1671 | 0.0747 |
| 0. | -20.00 | 15.0000 | 0.3252 | -0.2808 | 0.1591 | 0.0399 |
| 0. | -20.00 | 30.0000 | 0.3343 | -0.2835 | 0.1731 | 0.0374 |
| 0. | -20.00 | 45.0000 | 0.3535 | -0.2911 | 0.1975 | 0.0347 |
| 0. | -20.00 | 60.0000 | 0.3802 | -0.3094 | 0.2153 | 0.0500 |
| 0. | -20.00 | 75.0000 | 0.4181 | -0.3374 | 0.2391 | 0.0616 |
| 0. | -20.00 | 90.0000 | 0.4727 | -0.3909 | 0.2611 | 0.0497 |
| 0. | -20.00 | 105.0000 | 0.5082 | -0.4135 | 0.2950 | 0.0177 |
| 0. | -20.00 | 120.0000 | 0.5137 | -0.4031 | 0.3182 | -0.0121 |
| 0. | -20.00 | 135.0000 | 0.5046 | -0.3659 | 0.3240 | -0.0272 |
| 0. | -20.00 | 150.0000 | 0.4922 | -0.3650 | 0.3273 | -0.0443 |
| 0. | -20.00 | 165.0000 | 0.4655 | -0.3305 | 0.3227 | -0.0576 |
| 0. | -20.00 | 180.0000 | 0.4389 | -0.2923 | 0.3199 | -0.0697 |
| 0. | -20.00 | 195.0000 | 0.4217 | -0.2607 | 0.3244 | -0.0680 |
| 0. | -20.00 | 210.0000 | 0.3902 | -0.2231 | 0.3133 | -0.0657 |
| 0. | -20.00 | 225.0000 | 0.3660 | -0.1954 | 0.3027 | -0.0644 |
| 0. | -20.00 | 240.0000 | 0.3484 | -0.1729 | 0.2964 | -0.0605 |
| 0. | -20.00 | 255.0000 | 0.3272 | -0.1438 | 0.2865 | -0.0657 |
| 0. | -20.00 | 270.0000 | 0.2994 | -0.1041 | 0.2741 | -0.0605 |
| 0. | -20.00 | 285.0000 | 0.2732 | -0.0630 | 0.2631 | -0.0383 |
| 0. | -20.00 | 300.0000 | 0.2508 | -0.0475 | 0.2460 | 0.0125 |
| 0. | -20.00 | 315.0000 | 0.2465 | -0.0705 | 0.2279 | 0.0621 |
| 0. | -20.00 | 330.0000 | 0.2595 | -0.1255 | 0.2075 | 0.0925 |
| 0. | -20.00 | 345.0000 | 0.2878 | -0.1988 | 0.1820 | 0.1011 |
| 0. | -10.00 | 0. | 0.3202 | -0.2130 | 0.2285 | 0.0702 |
| 0. | -10.00 | 15.0000 | 0.3391 | -0.2432 | 0.2331 | 0.0391 |
| 0. | -10.00 | 30.0000 | 0.3433 | -0.2416 | 0.2429 | 0.0216 |
| 0. | -10.00 | 45.0000 | 0.3499 | -0.2294 | 0.2636 | 0.0174 |
| 0. | -10.00 | 60.0000 | 0.3724 | -0.2377 | 0.2844 | 0.0358 |
| 0. | -10.00 | 75.0000 | 0.4010 | -0.2602 | 0.3019 | 0.0441 |
| 0. | -10.00 | 90.0000 | 0.4403 | -0.2974 | 0.3231 | 0.0319 |
| 0. | -10.00 | 105.0000 | 0.4504 | -0.2958 | 0.3396 | -0.0024 |
| 0. | -10.00 | 120.0000 | 0.4478 | -0.2660 | 0.3595 | -0.0227 |
| 0. | -10.00 | 135.0000 | 0.4412 | -0.2426 | 0.3676 | -0.0261 |
| 0. | -10.00 | 150.0000 | 0.4287 | -0.2258 | 0.3623 | -0.0384 |
| 0. | -10.00 | 165.0000 | 0.4130 | -0.1990 | 0.3578 | -0.0540 |
| 0. | -10.00 | 180.0000 | 0.3926 | -0.1620 | 0.3521 | -0.0623 |
| 0. | -10.00 | 195.0000 | 0.3648 | -0.1301 | 0.3358 | -0.0588 |
| 0. | -10.00 | 210.0000 | 0.3471 | -0.1052 | 0.3259 | -0.0566 |
| 0. | -10.00 | 225.0000 | 0.3323 | -0.0869 | 0.3162 | -0.0536 |
| 0. | -10.00 | 240.0000 | 0.3184 | -0.0685 | 0.3064 | -0.0530 |
| 0. | -10.00 | 255.0000 | 0.3115 | -0.0480 | 0.3025 | -0.0565 |
| 0. | -10.00 | 270.0000 | 0.3037 | -0.0115 | 0.2987 | -0.0535 |
| 0. | -10.00 | 285.0000 | 0.2916 | 0.0254 | 0.2892 | -0.0280 |
| 0. | -10.00 | 300.0000 | 0.2803 | 0.0375 | 0.2767 | 0.0250 |
| 0. | -10.00 | 315.0000 | 0.2656 | -0.0004 | 0.2556 | 0.0720 |
| 0. | -10.00 | 330.0000 | 0.2637 | -0.0651 | 0.234[illegible] | 0.1024 |
| 0. | -10.00 | 345.0000 | 0.2923 | -0.1518 | 0.2260 | 0.1064 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 0. | 0.00 | 0. | 0.3138 | -0.1313 | 0.2782 | 0.0623 |
| 0. | 0.00 | 15.0000 | 0.3325 | -0.1441 | 0.2982 | 0.0302 |
| 0. | 0.00 | 30.0000 | 0.3418 | -0.1411 | 0.3111 | 0.0110 |
| 0. | 0.00 | 45.0000 | 0.3457 | -0.1215 | 0.3236 | 0.0064 |
| 0. | 0.00 | 60.0000 | 0.3627 | -0.1172 | 0.3426 | 0.0215 |
| 0. | 0.00 | 75.0000 | 0.3843 | -0.1351 | 0.3584 | 0.0315 |
| 0. | 0.00 | 90.0000 | 0.4101 | -0.1612 | 0.3765 | 0.0196 |
| 0. | 0.00 | 105.0000 | 0.4200 | -0.1514 | 0.3916 | -0.0109 |
| 0. | 0.00 | 120.0000 | 0.4043 | -0.1175 | 0.3861 | -0.0239 |
| 0. | 0.00 | 135.0000 | 0.3863 | -0.0956 | 0.3736 | -0.0217 |
| 0. | 0.00 | 150.0000 | 0.3732 | -0.0827 | 0.3627 | -0.0307 |
| 0. | 0.00 | 165.0000 | 0.3574 | -0.0597 | 0.3488 | -0.0502 |
| 0. | 0.00 | 180.0000 | 0.3440 | -0.0250 | 0.3389 | -0.0533 |
| 0. | 0.00 | 195.0000 | 0.3423 | 0.0014 | 0.3382 | -0.0528 |
| 0. | 0.00 | 210.0000 | 0.3326 | 0.0157 | 0.3285 | -0.0494 |
| 0. | 0.00 | 225.0000 | 0.3258 | 0.0272 | 0.3214 | -0.0462 |
| 0. | 0.00 | 240.0000 | 0.3284 | 0.0387 | 0.3220 | -0.0512 |
| 0. | 0.00 | 255.0000 | 0.3298 | 0.0627 | 0.3195 | -0.0527 |
| 0. | 0.00 | 270.0000 | 0.3323 | 0.0987 | 0.3134 | -0.0495 |
| 0. | 0.00 | 285.0000 | 0.3360 | 0.1372 | 0.3062 | -0.0186 |
| 0. | 0.00 | 300.0000 | 0.3213 | 0.1387 | 0.2878 | 0.0345 |
| 0. | 0.00 | 315.0000 | 0.3048 | 0.0937 | 0.2785 | 0.0811 |
| 0. | 0.00 | 330.0000 | 0.2944 | 0.0169 | 0.2724 | 0.1103 |
| 0. | 0.00 | 345.0000 | 0.2945 | -0.0738 | 0.2658 | 0.1030 |
| 0. | 10.00 | 0. | 0.3228 | -0.0107 | 0.3190 | 0.0480 |
| 0. | 10.00 | 15.0000 | 0.3347 | -0.0119 | 0.3338 | 0.0212 |
| 0. | 10.00 | 30.0000 | 0.3469 | 0.0012 | 0.3469 | 0.0034 |
| 0. | 10.00 | 45.0000 | 0.3547 | 0.0169 | 0.3543 | -0.0005 |
| 0. | 10.00 | 60.0000 | 0.3691 | 0.0295 | 0.3678 | 0.0084 |
| 0. | 10.00 | 75.0000 | 0.3884 | 0.0183 | 0.3875 | 0.0199 |
| 0. | 10.00 | 90.0000 | 0.4050 | 0.0048 | 0.4048 | 0.0116 |
| 0. | 10.00 | 105.0000 | 0.3997 | 0.0124 | 0.3994 | -0.0099 |
| 0. | 10.00 | 120.0000 | 0.3908 | 0.0321 | 0.3893 | -0.0139 |
| 0. | 10.00 | 135.0000 | 0.3749 | 0.0423 | 0.3723 | -0.0121 |
| 0. | 10.00 | 150.0000 | 0.3533 | 0.0466 | 0.3496 | -0.0208 |
| 0. | 10.00 | 165.0000 | 0.3438 | 0.0645 | 0.3352 | -0.0416 |
| 0. | 10.00 | 180.0000 | 0.3348 | 0.0893 | 0.3193 | -0.0467 |
| 0. | 10.00 | 195.0000 | 0.3301 | 0.1120 | 0.3064 | -0.0502 |
| 0. | 10.00 | 210.0000 | 0.3381 | 0.1280 | 0.3091 | -0.0483 |
| 0. | 10.00 | 225.0000 | 0.3486 | 0.1405 | 0.3151 | -0.0496 |
| 0. | 10.00 | 240.0000 | 0.3595 | 0.1611 | 0.3172 | -0.0515 |
| 0. | 10.00 | 255.0000 | 0.3722 | 0.1862 | 0.3180 | -0.0523 |
| 0. | 10.00 | 270.0000 | 0.3884 | 0.2224 | 0.3151 | -0.0460 |
| 0. | 10.00 | 285.0000 | 0.3963 | 0.2582 | 0.3006 | -0.0075 |
| 0. | 10.00 | 300.0000 | 0.3802 | 0.2472 | 0.2855 | 0.0440 |
| 0. | 10.00 | 315.0000 | 0.3537 | 0.2016 | 0.2782 | 0.0842 |
| 0. | 10.00 | 330.0000 | 0.3267 | 0.1228 | 0.2810 | 0.1129 |
| 0. | 10.00 | 345.0000 | 0.3141 | 0.0259 | 0.2975 | 0.0974 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 0. | 20.00 | 0. | 0.3529 | 0.1259 | 0.3273 | 0.0392 |
| 0. | 20.00 | 15.0000 | 0.3598 | 0.1302 | 0.3350 | 0.0180 |
| 0. | 20.00 | 30.0000 | 0.3731 | 0.1472 | 0.3428 | -0.0051 |
| 0. | 20.00 | 45.0000 | 0.3890 | 0.1641 | 0.3526 | -0.0088 |
| 0. | 20.00 | 60.0000 | 0.4091 | 0.1826 | 0.3661 | -0.0011 |
| 0. | 20.00 | 75.0000 | 0.4271 | 0.1856 | 0.3846 | 0.0060 |
| 0. | 20.00 | 90.0000 | 0.4369 | 0.1825 | 0.3968 | 0.0069 |
| 0. | 20.00 | 105.0000 | 0.4345 | 0.1769 | 0.3968 | -0.0025 |
| 0. | 20.00 | 120.0000 | 0.4230 | 0.1876 | 0.3791 | -0.0007 |
| 0. | 20.00 | 135.0000 | 0.3924 | 0.1750 | 0.3512 | 0.0053 |
| 0. | 20.00 | 150.0000 | 0.3645 | 0.1573 | 0.3287 | -0.0061 |
| 0. | 20.00 | 165.0000 | 0.3426 | 0.1605 | 0.3012 | -0.0296 |
| 0. | 20.00 | 180.0000 | 0.3432 | 0.1820 | 0.2880 | -0.0417 |
| 0. | 20.00 | 195.0000 | 0.3559 | 0.2053 | 0.2861 | -0.0516 |
| 0. | 20.00 | 210.0000 | 0.3674 | 0.2249 | 0.2854 | -0.0545 |
| 0. | 20.00 | 225.0000 | 0.3899 | 0.2507 | 0.2934 | -0.0558 |
| 0. | 20.00 | 240.0000 | 0.4162 | 0.2789 | 0.3034 | -0.0578 |
| 0. | 20.00 | 255.0000 | 0.4388 | 0.3101 | 0.3056 | -0.0551 |
| 0. | 20.00 | 270.0000 | 0.4584 | 0.3501 | 0.2934 | -0.0375 |
| 0. | 20.00 | 285.0000 | 0.4605 | 0.3712 | 0.2724 | 0.0059 |
| 0. | 20.00 | 300.0000 | 0.4369 | 0.3477 | 0.2594 | 0.0524 |
| 0. | 20.00 | 315.0000 | 0.3999 | 0.2925 | 0.2585 | 0.0866 |
| 0. | 20.00 | 330.0000 | 0.3691 | 0.2234 | 0.2735 | 0.1071 |
| 0. | 20.00 | 345.0000 | 0.3514 | 0.1529 | 0.3061 | 0.0803 |
| 0. | 30.00 | 0. | 0.3986 | 0.2633 | 0.2977 | 0.0302 |
| 0. | 30.00 | 15.0000 | 0.4041 | 0.2622 | 0.3070 | 0.0161 |
| 0. | 30.00 | 30.0000 | 0.4175 | 0.2796 | 0.3098 | -0.0099 |
| 0. | 30.00 | 45.0000 | 0.4361 | 0.3016 | 0.3173 | -0.0174 |
| 0. | 30.00 | 60.0000 | 0.4616 | 0.3260 | 0.3265 | -0.0119 |
| 0. | 30.00 | 75.0000 | 0.4746 | 0.3351 | 0.3361 | -0.0040 |
| 0. | 30.00 | 90.0000 | 0.4856 | 0.3372 | 0.3494 | 0.0012 |
| 0. | 30.00 | 105.0000 | 0.4866 | 0.3357 | 0.3523 | 0.0027 |
| 0. | 30.00 | 120.0000 | 0.4716 | 0.3270 | 0.3395 | 0.0147 |
| 0. | 30.00 | 135.0000 | 0.4455 | 0.3002 | 0.3284 | 0.0215 |
| 0. | 30.00 | 150.0000 | 0.4087 | 0.2693 | 0.3073 | 0.0111 |
| 0. | 30.00 | 165.0000 | 0.3821 | 0.2507 | 0.2881 | -0.0129 |
| 0. | 30.00 | 180.0000 | 0.3717 | 0.2571 | 0.2658 | -0.0378 |
| 0. | 30.00 | 195.0000 | 0.3868 | 0.2830 | 0.2580 | -0.0542 |
| 0. | 30.00 | 210.0000 | 0.4099 | 0.3114 | 0.2592 | -0.0617 |
| 0. | 30.00 | 225.0000 | 0.4424 | 0.3493 | 0.2627 | -0.0688 |
| 0. | 30.00 | 240.0000 | 0.4746 | 0.3695 | 0.2637 | -0.0644 |
| 0. | 30.00 | 255.0000 | 0.5072 | 0.4309 | 0.2618 | -0.0550 |
| 0. | 30.00 | 270.0000 | 0.5228 | 0.4589 | 0.2490 | -0.0263 |
| 0. | 30.00 | 285.0000 | 0.5189 | 0.4637 | 0.2322 | 0.0175 |
| 0. | 30.00 | 300.0000 | 0.4933 | 0.4344 | 0.2256 | 0.0610 |
| 0. | 30.00 | 315.0000 | 0.4552 | 0.3820 | 0.2315 | 0.0876 |
| 0. | 30.00 | 330.0000 | 0.4106 | 0.3117 | 0.2511 | 0.0914 |
| 0. | 30.00 | 345.0000 | 0.4015 | 0.2762 | 0.2832 | 0.0690 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 0. | 40.00 | 0. | 0.4335 | 0.3575 | 0.2436 | 0.0279 |
| 0. | 40.00 | 15.0000 | 0.4387 | 0.3605 | 0.2498 | 0.0092 |
| 0. | 40.00 | 30.0000 | 0.4575 | 0.3793 | 0.2555 | -0.0108 |
| 0. | 40.00 | 45.0000 | 0.4750 | 0.4001 | 0.2547 | -0.0247 |
| 0. | 40.00 | 60.0000 | 0.5023 | 0.4283 | 0.2615 | -0.0233 |
| 0. | 40.00 | 75.0000 | 0.5246 | 0.4463 | 0.2754 | -0.0147 |
| 0. | 40.00 | 90.0000 | 0.5436 | 0.4624 | 0.2856 | -0.0108 |
| 0. | 40.00 | 105.0000 | 0.5546 | 0.4691 | 0.2957 | 0.0068 |
| 0. | 40.00 | 120.0000 | 0.5374 | 0.4498 | 0.2930 | 0.0250 |
| 0. | 40.00 | 135.0000 | 0.4997 | 0.4119 | 0.2804 | 0.0377 |
| 0. | 40.00 | 150.0000 | 0.4524 | 0.3624 | 0.2695 | 0.0271 |
| 0. | 40.00 | 165.0000 | 0.4256 | 0.3381 | 0.2586 | -0.0006 |
| 0. | 40.00 | 180.0000 | 0.4169 | 0.3327 | 0.2491 | -0.0335 |
| 0. | 40.00 | 195.0000 | 0.4367 | 0.3613 | 0.2393 | -0.0544 |
| 0. | 40.00 | 210.0000 | 0.4624 | 0.3931 | 0.2332 | -0.0705 |
| 0. | 40.00 | 225.0000 | 0.4973 | 0.4356 | 0.2277 | -0.0755 |
| 0. | 40.00 | 240.0000 | 0.5329 | 0.4806 | 0.2195 | -0.0698 |
| 0. | 40.00 | 255.0000 | 0.5661 | 0.5248 | 0.2058 | -0.0520 |
| 0. | 40.00 | 270.0000 | 0.5790 | 0.5477 | 0.1871 | -0.0141 |
| 0. | 40.00 | 285.0000 | 0.5659 | 0.5372 | 0.1759 | 0.0273 |
| 0. | 40.00 | 300.0000 | 0.5324 | 0.4985 | 0.1736 | 0.0692 |
| 0. | 40.00 | 315.0000 | 0.4976 | 0.4522 | 0.1907 | 0.0821 |
| 0. | 40.00 | 330.0000 | 0.4646 | 0.4028 | 0.2192 | 0.0744 |
| 0. | 40.00 | 345.0000 | 0.4541 | 0.3826 | 0.2350 | 0.0678 |
| 0. | 50.00 | 0. | 0.4689 | 0.4257 | 0.1947 | 0.0276 |
| 0. | 50.00 | 15.0000 | 0.4758 | 0.4306 | 0.2024 | 0.0051 |
| 0. | 50.00 | 30.0000 | 0.4850 | 0.4421 | 0.1990 | -0.0132 |
| 0. | 50.00 | 45.0000 | 0.5076 | 0.4653 | 0.2008 | -0.0294 |
| 0. | 50.00 | 60.0000 | 0.5373 | 0.4982 | 0.1982 | -0.0359 |
| 0. | 50.00 | 75.0000 | 0.5624 | 0.5242 | 0.2022 | -0.0258 |
| 0. | 50.00 | 90.0000 | 0.5829 | 0.5431 | 0.2105 | -0.0203 |
| 0. | 50.00 | 105.0000 | 0.5916 | 0.5541 | 0.2071 | 0.0059 |
| 0. | 50.00 | 120.0000 | 0.5800 | 0.5383 | 0.2143 | 0.0261 |
| 0. | 50.00 | 135.0000 | 0.5569 | 0.5045 | 0.2318 | 0.0435 |
| 0. | 50.00 | 150.0000 | 0.5188 | 0.4574 | 0.2426 | 0.0336 |
| 0. | 50.00 | 165.0000 | 0.4971 | 0.4334 | 0.2431 | 0.0090 |
| 0. | 50.00 | 180.0000 | 0.4761 | 0.4183 | 0.2263 | -0.0227 |
| 0. | 50.00 | 195.0000 | 0.4839 | 0.4347 | 0.2061 | -0.0515 |
| 0. | 50.00 | 210.0000 | 0.5066 | 0.4641 | 0.1892 | -0.0743 |
| 0. | 50.00 | 225.0000 | 0.5457 | 0.5109 | 0.1754 | -0.0773 |
| 0. | 50.00 | 240.0000 | 0.5777 | 0.5514 | 0.1579 | -0.0686 |
| 0. | 50.00 | 255.0000 | 0.5994 | 0.5831 | 0.1341 | -0.0371 |
| 0. | 50.00 | 270.0000 | 0.5946 | 0.5839 | 0.1124 | -0.0018 |
| 0. | 50.00 | 285.0000 | 0.5861 | 0.5752 | 0.1076 | 0.0326 |
| 0. | 50.00 | 300.0000 | 0.5601 | 0.5415 | 0.1261 | 0.0673 |
| 0. | 50.00 | 315.0000 | 0.5263 | 0.5012 | 0.1408 | 0.0771 |
| 0. | 50.00 | 330.0000 | 0.4943 | 0.4633 | 0.1557 | 0.0739 |
| 0. | 50.00 | 345.0000 | 0.4724 | 0.4355 | 0.1742 | 0.0562 |

| H (feet) | THETA (degrees) | PHI (deg | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 0. | 60.00 | 0. | 0.4933 | 0.4707 | 0.1459 | 0.0237 |
| 0. | 60.00 | 15.0000 | 0.4997 | 0.4770 | 0.1487 | 0.0043 |
| 0. | 60.00 | 30.0000 | 0.5083 | 0.4860 | 0.1485 | -0.0142 |
| 0. | 60.00 | 45.0000 | 0.5236 | 0.5043 | 0.1380 | -0.0280 |
| 0. | 60.00 | 60.0000 | 0.5378 | 0.5205 | 0.1297 | -0.0391 |
| 0. | 60.00 | 75.0000 | 0.5744 | 0.5573 | 0.1305 | -0.0485 |
| 0. | 60.00 | 90.0000 | 0.6127 | 0.5970 | 0.1346 | -0.0290 |
| 0. | 60.00 | 105.0000 | 0.6164 | 0.5988 | 0.1461 | -0.0002 |
| 0. | 60.00 | 120.0000 | 0.6182 | 0.5970 | 0.1598 | 0.0146 |
| 0. | 60.00 | 135.0000 | 0.6027 | 0.5780 | 0.1658 | 0.0411 |
| 0. | 60.00 | 150.0000 | 0.5639 | 0.5360 | 0.1717 | 0.0341 |
| 0. | 60.00 | 165.0000 | 0.5451 | 0.5158 | 0.1757 | 0.0178 |
| 0. | 60.00 | 180.0000 | 0.5261 | 0.4943 | 0.1798 | -0.0121 |
| 0. | 60.00 | 195.0000 | 0.5320 | 0.5020 | 0.1702 | -0.0458 |
| 0. | 60.00 | 210.0000 | 0.5497 | 0.5246 | 0.1502 | -0.0660 |
| 0. | 60.00 | 225.0000 | 0.5772 | 0.5601 | 0.1201 | -0.0707 |
| 0. | 60.00 | 240.0000 | 0.5967 | 0.5870 | 0.0926 | -0.0543 |
| 0. | 60.00 | 255.0000 | 0.6071 | 0.6021 | 0.0744 | -0.0234 |
| 0. | 60.00 | 270.0000 | 0.5924 | 0.5884 | 0.0669 | 0.0164 |
| 0. | 60.00 | 285.0000 | 0.5694 | 0.5648 | 0.0632 | 0.0344 |
| 0. | 60.00 | 300.0000 | 0.5660 | 0.5587 | 0.0710 | 0.0562 |
| 0. | 60.00 | 315.0000 | 0.5392 | 0.5254 | 0.0923 | 0.0783 |
| 0. | 60.00 | 330.0000 | 0.5076 | 0.4894 | 0.1168 | 0.0667 |
| 0. | 60.00 | 345.0000 | 0.4970 | 0.4755 | 0.1367 | 0.0468 |
| 0. | 70.00 | 0. | 0.5160 | 0.5044 | 0.1065 | 0.0219 |
| 0. | 70.00 | 15.0000 | 0.5201 | 0.5083 | 0.1104 | 0.0052 |
| 0. | 70.00 | 30.0000 | 0.5227 | 0.5114 | 0.1080 | -0.0079 |
| 0. | 70.00 | 45.0000 | 0.5246 | 0.5139 | 0.1028 | -0.0236 |
| 0. | 70.00 | 60.0000 | 0.5384 | 0.5282 | 0.0945 | -0.0444 |
| 0. | 70.00 | 75.0000 | 0.5689 | 0.5605 | 0.0799 | -0.0557 |
| 0. | 70.00 | 90.0000 | 0.6006 | 0.5949 | 0.0663 | -0.0459 |
| 0. | 70.00 | 105.0000 | 0.6249 | 0.6207 | 0.0679 | -0.0255 |
| 0. | 70.00 | 120.0000 | 0.6376 | 0.6332 | 0.0745 | 0.0037 |
| 0. | 70.00 | 135.0000 | 0.6233 | 0.6156 | 0.0923 | 0.0320 |
| 0. | 70.00 | 150.0000 | 0.5951 | 0.5833 | 0.1137 | 0.0304 |
| 0. | 70.00 | 165.0000 | 0.5792 | 0.5659 | 0.1229 | 0.0106 |
| 0. | 70.00 | 180.0000 | 0.5720 | 0.5590 | 0.1207 | -0.0103 |
| 0. | 70.00 | 195.0000 | 0.5695 | 0.5585 | 0.1068 | -0.0307 |
| 0. | 70.00 | 210.0000 | 0.5727 | 0.5645 | 0.0853 | -0.0449 |
| 0. | 70.00 | 225.0000 | 0.5815 | 0.5761 | 0.0618 | -0.0488 |
| 0. | 70.00 | 240.0000 | 0.5936 | 0.5909 | 0.0407 | -0.0399 |
| 0. | 70.00 | 255.0000 | 0.6047 | 0.6040 | 0.0250 | -0.0155 |
| 0. | 70.00 | 270.0000 | 0.6011 | 0.6003 | 0.0223 | 0.0199 |
| 0. | 70.00 | 285.0000 | 0.5822 | 0.5797 | 0.0305 | 0.0446 |
| 0. | 70.00 | 300.0000 | 0.5629 | 0.5583 | 0.0411 | 0.0596 |
| 0. | 70.00 | 315.0000 | 0.5413 | 0.5338 | 0.0593 | 0.0675 |
| 0. | 70.00 | 330.0000 | 0.5227 | 0.5134 | 0.0799 | 0.0576 |
| 0. | 70.00 | 345.0000 | 0.5158 | 0.5053 | 0.0954 | 0.0402 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 0. | 80.00 | 0. | 0.5372 | 0.5319 | 0.0728 | 0.0190 |
| 0. | 80.00 | 15.0000 | 0.5398 | 0.5343 | 0.0764 | 0.0048 |
| 0. | 80.00 | 30.0000 | 0.5432 | 0.5376 | 0.0768 | -0.0092 |
| 0. | 30.00 | 45.0000 | 0.5481 | 0.5427 | 0.0730 | -0.0240 |
| 0. | 80.00 | 60.0000 | 0.5564 | 0.5514 | 0.0636 | -0.0376 |
| 0. | 30.00 | 75.0000 | 0.5683 | 0.5643 | 0.0492 | -0.0454 |
| 0. | 80.00 | 90.0000 | 0.5820 | 0.5793 | 0.0336 | -0.0443 |
| 0. | 80.00 | 105.0000 | 0.5943 | 0.5929 | 0.0215 | -0.0341 |
| 0. | 80.00 | 120.0000 | 0.6022 | 0.6016 | 0.0170 | -0.0182 |
| 0. | 80.00 | 135.0000 | 0.6036 | 0.6032 | 0.0211 | -0.0033 |
| 0. | 80.00 | 150.0000 | 0.5995 | 0.5987 | 0.0300 | 0.0044 |
| 0. | 80.00 | 165.0000 | 0.5924 | 0.5912 | 0.0379 | 0.0036 |
| 0. | 80.00 | 180.0000 | 0.5851 | 0.5836 | 0.0409 | -0.0033 |
| 0. | 80.00 | 195.0000 | 0.5796 | 0.5782 | 0.0376 | -0.0125 |
| 0. | 80.00 | 210.0000 | 0.5774 | 0.5764 | 0.0279 | -0.0197 |
| 0. | 80.00 | 225.0000 | 0.5780 | 0.5774 | 0.0139 | -0.0202 |
| 0. | 80.00 | 240.0000 | 0.5788 | 0.5787 | -0.0001 | -0.0116 |
| 0. | 80.00 | 255.0000 | 0.5773 | 0.5772 | -0.0090 | 0.0047 |
| 0. | 80.00 | 270.0000 | 0.5723 | 0.5717 | -0.0092 | 0.0238 |
| 0. | 80.00 | 285.0000 | 0.5644 | 0.5629 | -0.0005 | 0.0404 |
| 0. | 60.00 | 300.0000 | 0.5552 | 0.5527 | 0.0148 | 0.0506 |
| 0. | 80.00 | 315.0000 | 0.5463 | 0.5427 | 0.0334 | 0.0526 |
| 0. | 80.00 | 330.0000 | 0.5396 | 0.5351 | 0.0512 | 0.0461 |
| 0. | 80.00 | 345.0000 | 0.5365 | 0.5316 | 0.0647 | 0.0335 |
| 0. | 90.00 | 0. | 0.5683 | 0.5673 | 0 | 0 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | $B_z$ (oersteds) | $B_y$ (oersteds) | $B_x$ (oersteds) |
|---|---|---|---|---|---|---|
| 50000. | -90.00 | 0. | 0.5594 | -0.5396 | 0 | 0 |
| 50000. | -80.00 | 0. | 0.5212 | -0.4951 | 0.1428 | 0.0786 |
| 50000. | -80.00 | 15.0000 | 0.5281 | -0.5048 | 0.1195 | 0.0991 |
| 50000. | -80.00 | 30.0000 | 0.5344 | -0.5144 | 0.0920 | 0.1115 |
| 50000. | -80.00 | 45.0000 | 0.5391 | -0.5222 | 0.0643 | 0.1177 |
| 50000. | -80.00 | 60.0000 | 0.5441 | -0.5291 | 0.0368 | 0.1216 |
| 50000. | -80.00 | 75.0000 | 0.5518 | -0.5379 | 0.0071 | 0.1228 |
| 50000. | -80.00 | 90.0000 | 0.5626 | -0.5497 | -0.0239 | 0.1173 |
| 50000. | -80.00 | 105.0000 | 0.5758 | -0.5640 | -0.0510 | 0.1043 |
| 50000. | -80.00 | 120.0000 | 0.5933 | -0.5825 | -0.0721 | 0.0868 |
| 50000. | -80.00 | 135.0000 | 0.6174 | -0.6075 | -0.0901 | 0.0636 |
| 50000. | -80.00 | 150.0000 | 0.6442 | -0.6348 | -0.1063 | 0.0270 |
| 50000. | -80.00 | 165.0000 | 0.6622 | -0.6517 | -0.1144 | -0.0273 |
| 50000. | -80.00 | 180.0000 | 0.6606 | -0.6459 | -0.1049 | -0.0901 |
| 50000. | -80.00 | 195.0000 | 0.6371 | -0.6154 | -0.0751 | -0.1426 |
| 50000. | -80.00 | 210.0000 | 0.6002 | -0.5745 | -0.0320 | -0.1709 |
| 50000. | -80.00 | 225.0000 | 0.5625 | -0.5347 | 0.0146 | -0.1737 |
| 50000. | -80.00 | 240.0000 | 0.5335 | -0.5060 | 0.0576 | -0.1588 |
| 50000. | -80.00 | 255.0000 | 0.5159 | -0.4889 | 0.0946 | -0.1349 |
| 50000. | -80.00 | 270.0000 | 0.5068 | -0.4794 | 0.1233 | -0.1064 |
| 50000. | -80.00 | 285.0000 | 0.5028 | -0.4747 | 0.1483 | -0.0739 |
| 50000. | -80.00 | 300.0000 | 0.5026 | -0.4741 | 0.1619 | -0.0398 |
| 50000. | -80.00 | 315.0000 | 0.5053 | -0.4768 | 0.1671 | -0.0072 |
| 50000. | -80.00 | 330.0000 | 0.5096 | -0.4813 | 0.1660 | 0.0232 |
| 50000. | -80.00 | 345.0000 | 0.5149 | -0.4871 | 0.1584 | 0.0522 |
| 50000. | -70.00 | 0. | 0.4487 | -0.4056 | 0.1767 | 0.0747 |
| 50000. | -70.00 | 15.0000 | 0.4685 | -0.4286 | 0.1604 | 0.1007 |
| 50000. | -70.00 | 30.0000 | 0.4976 | -0.4645 | 0.1367 | 0.1146 |
| 50000. | -70.00 | 45.0000 | 0.5140 | -0.4902 | 0.1089 | 0.1098 |
| 50000. | -70.00 | 60.0000 | 0.5167 | -0.4973 | 0.0852 | 0.1113 |
| 50000. | -70.00 | 75.0000 | 0.5397 | -0.5207 | 0.0583 | 0.1296 |
| 50000. | -70.00 | 90.0000 | 0.5874 | -0.5720 | 0.0227 | 0.1316 |
| 50000. | -70.00 | 105.0000 | 0.6259 | -0.6174 | -0.0112 | 0.1022 |
| 50000. | -70.00 | 120.0000 | 0.6388 | -0.6351 | -0.0304 | 0.0616 |
| 50000. | -70.00 | 135.0000 | 0.6398 | -0.6382 | -0.0293 | 0.0337 |
| 50000. | -70.00 | 150.0000 | 0.6566 | -0.6561 | -0.0189 | 0.0187 |
| 50000. | -70.00 | 165.0000 | 0.6924 | -0.6921 | -0.0119 | -0.0152 |
| 50000. | -70.00 | 180.0000 | 0.7087 | -0.7046 | 0.0031 | -0.0760 |
| 50000. | -70.00 | 195.0000 | 0.6899 | -0.6784 | 0.0264 | -0.1226 |
| 50000. | -70.00 | 210.0000 | 0.6540 | -0.6360 | 0.0439 | -0.1459 |
| 50000. | -70.00 | 225.0000 | 0.6068 | -0.5832 | 0.0605 | -0.1562 |
| 50000. | -70.00 | 240.0000 | 0.5560 | -0.5281 | 0.0649 | -0.1524 |
| 50000. | -70.00 | 255.0000 | 0.5148 | -0.4824 | 0.1144 | -0.1385 |
| 50000. | -70.00 | 270.0000 | 0.4822 | -0.4438 | 0.1484 | -0.1163 |
| 50000. | -70.00 | 285.0000 | 0.4600 | -0.4168 | 0.1783 | -0.0782 |
| 50000. | -70.00 | 300.0000 | 0.4578 | -0.4129 | 0.1944 | -0.0363 |
| 50000. | -70.00 | 315.0000 | 0.4609 | -0.4152 | 0.1998 | -0.0091 |
| 50000. | -70.00 | 330.0000 | 0.4527 | -0.4062 | 0.1992 | 0.0139 |
| 50000. | -70.00 | 345.0000 | 0.4441 | -0.3985 | 0.1909 | 0.0443 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 50000. | -60.00 | 0. | 0.3801 | -0.3364 | 0.1617 | 0.0718 |
| 50000. | -60.00 | 15.0000 | 0.3883 | -0.3494 | 0.1488 | 0.0810 |
| 50000. | -60.00 | 30.0000 | 0.4125 | -0.3736 | 0.1442 | 0.0986 |
| 50000. | -60.00 | 45.0000 | 0.4508 | -0.4159 | 0.1355 | 0.1002 |
| 50000. | -60.00 | 60.0000 | 0.4805 | -0.4539 | 0.1125 | 0.1106 |
| 50000. | -60.00 | 75.0000 | 0.5134 | -0.4913 | 0.0914 | 0.1180 |
| 50000. | -60.00 | 90.0000 | 0.5583 | -0.5400 | 0.0813 | 0.1157 |
| 50000. | -60.00 | 105.0000 | 0.6063 | -0.5939 | 0.0698 | 0.1001 |
| 50000. | -60.00 | 120.0000 | 0.6441 | -0.6388 | 0.0558 | 0.0608 |
| 50000. | -60.00 | 135.0000 | 0.6638 | -0.6617 | 0.0480 | 0.0233 |
| 50000. | -60.00 | 150.0000 | 0.6791 | -0.6766 | 0.0587 | -0.0037 |
| 50000. | -60.00 | 165.0000 | 0.7122 | -0.7063 | 0.0839 | -0.0351 |
| 50000. | -60.00 | 180.0000 | 0.7010 | -0.6842 | 0.1151 | -0.0999 |
| 50000. | -60.00 | 195.0000 | 0.6413 | -0.6131 | 0.1428 | -0.1223 |
| 50000. | -60.00 | 210.0000 | 0.5977 | -0.5625 | 0.1637 | -0.1187 |
| 50000. | -60.00 | 225.0000 | 0.5699 | -0.5330 | 0.1693 | -0.1094 |
| 50000. | -60.00 | 240.0000 | 0.5486 | -0.5109 | 0.1627 | -0.1159 |
| 50000. | -60.00 | 255.0000 | 0.5107 | -0.4646 | 0.1710 | -0.1251 |
| 50000. | -60.00 | 270.0000 | 0.4651 | -0.4093 | 0.1880 | -0.1159 |
| 50000. | -60.00 | 285.0000 | 0.4207 | -0.3549 | 0.2085 | -0.0870 |
| 50000. | -60.00 | 300.0000 | 0.3956 | -0.3220 | 0.2258 | -0.0426 |
| 50000. | -60.00 | 315.0000 | 0.3810 | -0.3068 | 0.2259 | -0.0011 |
| 50000. | -60.00 | 330.0000 | 0.3705 | -0.3072 | 0.2047 | 0.0313 |
| 50000. | -60.00 | 345.0000 | 0.3690 | -0.3161 | 0.1818 | 0.0566 |
| 50000. | -50.00 | 0. | 0.3268 | -0.2838 | 0.1850 | 0.0722 |
| 50000. | -50.00 | 15.0000 | 0.3467 | -0.3110 | 0.1331 | 0.0759 |
| 50000. | -50.00 | 30.0000 | 0.3712 | -0.3389 | 0.1305 | 0.0769 |
| 50000. | -50.00 | 45.0000 | 0.3968 | -0.3632 | 0.1326 | 0.0895 |
| 50000. | -50.00 | 60.0000 | 0.4359 | -0.4034 | 0.1299 | 0.1020 |
| 50000. | -50.00 | 75.0000 | 0.4832 | -0.4564 | 0.1141 | 0.1102 |
| 50000. | -50.00 | 90.0000 | 0.5291 | -0.5100 | 0.0980 | 0.1010 |
| 50000. | -50.00 | 105.0000 | 0.5860 | -0.5718 | 0.0935 | 0.0879 |
| 50000. | -50.00 | 120.0000 | 0.6295 | -0.6197 | 0.1024 | 0.0424 |
| 50000. | -50.00 | 135.0000 | 0.6520 | -0.6409 | 0.1198 | 0.0066 |
| 50000. | -50.00 | 150.0000 | 0.6409 | -0.6217 | 0.1502 | -0.0413 |
| 50000. | -50.00 | 165.0000 | 0.6306 | -0.6025 | 0.1779 | -0.0545 |
| 50000. | -50.00 | 180.0000 | 0.6098 | -0.5730 | 0.1894 | -0.0876 |
| 50000. | -50.00 | 195.0000 | 0.5772 | -0.5366 | 0.1880 | -0.0997 |
| 50000. | -50.00 | 210.0000 | 0.5321 | -0.4875 | 0.1863 | -0.1036 |
| 50000. | -50.00 | 225.0000 | 0.4982 | -0.4503 | 0.1926 | -0.0913 |
| 50000. | -50.00 | 240.0000 | 0.4885 | -0.4326 | 0.2060 | -0.0950 |
| 50000. | -50.00 | 255.0000 | 0.4556 | -0.3886 | 0.2115 | -0.1088 |
| 50000. | -50.00 | 270.0000 | 0.4113 | -0.3313 | 0.2205 | -0.1038 |
| 50000. | -50.00 | 285.0000 | 0.3630 | -0.2684 | 0.2303 | -0.0816 |
| 50000. | -50.00 | 300.0000 | 0.3247 | -0.2285 | 0.2287 | -0.0304 |
| 50000. | -50.00 | 315.0000 | 0.3073 | -0.2238 | 0.2098 | 0.0188 |
| 50000. | -50.00 | 330.0000 | 0.3103 | -0.2424 | 0.1876 | 0.0467 |
| 50000. | -50.00 | 345.0000 | 0.3130 | -0.2596 | 0.1623 | 0.0654 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 50000. | -40.00 | 0. | 0.2979 | -0.2593 | 0.1278 | 0.0719 |
| 50000. | -40.00 | 15.0000 | 0.3226 | -0.2899 | 0.1276 | 0.0612 |
| 50000. | -40.00 | 30.0000 | 0.3336 | -0.2985 | 0.1353 | 0.0619 |
| 50000. | -40.00 | 45.0000 | 0.3621 | -0.3274 | 0.1358 | 0.0741 |
| 50000. | -40.00 | 60.0000 | 0.4042 | -0.3673 | 0.1436 | 0.0887 |
| 50000. | -40.00 | 75.0000 | 0.4690 | -0.4338 | 0.1471 | 0.1006 |
| 50000. | -40.00 | 90.0000 | 0.5302 | -0.5009 | 0.1489 | 0.0899 |
| 50000. | -40.00 | 105.0000 | 0.5780 | -0.5524 | 0.1588 | 0.0613 |
| 50000. | -40.00 | 120.0000 | 0.[illegible]104 | -0.5847 | 0.1735 | 0.0237 |
| 50000. | -40.00 | 135.0000 | 0.6227 | -0.5921 | 0.1925 | -0.0111 |
| 50000. | -40.00 | 150.0000 | 0.6022 | -0.5669 | 0.1979 | -0.0466 |
| 50000. | -40.00 | 165.0000 | 0.5882 | -0.5466 | 0.2087 | -0.0612 |
| 50000. | -40.00 | 180.0000 | 0.5603 | -0.5067 | 0.2239 | -0.0842 |
| 50000. | -40.00 | 195.0000 | 0.5160 | -0.4505 | 0.2357 | -0.0885 |
| 50000. | -40.00 | 210.0000 | 0.4919 | -0.4261 | 0.2321 | -0.0809 |
| 50000. | -40.00 | 225.0000 | 0.4674 | -0.3947 | 0.2355 | -0.0850 |
| 50000. | -40.00 | 240.0000 | 0.4397 | -0.3579 | 0.2404 | -0.0864 |
| 50000. | -40.00 | 255.0000 | 0.4072 | -0.3155 | 0.2402 | -0.0924 |
| 50000. | -40.00 | 270.0000 | 0.3608 | -0.2572 | 0.2363 | -0.0903 |
| 50000. | -40.00 | 285.0000 | 0.3096 | -0.1967 | 0.2282 | -0.0671 |
| 50000. | -40.00 | 300.0000 | 0.2695 | -0.1574 | 0.2182 | -0.0160 |
| 50000. | -40.00 | 315.0000 | 0.2619 | -0.1618 | 0.2033 | 0.0333 |
| 50000. | -40.00 | 330.0000 | 0.2676 | -0.1890 | 0.1775 | 0.0662 |
| 50000. | -40.00 | 345.0000 | 0.2821 | -0.2289 | 0.1458 | 0.0768 |
| 50000. | -30.00 | 0. | 0.3002 | -0.2634 | 0.1257 | 0.0704 |
| 50000. | -30.00 | 15.0000 | 0.3039 | -0.2716 | 0.1287 | 0.0453 |
| 50000. | -30.00 | 30.0000 | 0.3201 | -0.2851 | 0.1340 | 0.0568 |
| 50000. | -30.00 | 45.0000 | 0.3529 | -0.3151 | 0.1507 | 0.0506 |
| 50000. | -30.00 | 60.0000 | 0.3842 | -0.3379 | 0.1687 | 0.0707 |
| 50000. | -30.00 | 75.0000 | 0.4414 | -0.3914 | 0.1870 | 0.0618 |
| 50000. | -30.00 | 90.0000 | 0.4997 | -0.4524 | 0.2009 | 0.0686 |
| 50000. | -30.00 | 105.0000 | 0.5460 | -0.4978 | 0.2199 | 0.0441 |
| 50000. | -30.00 | 120.0000 | 0.5720 | -0.5146 | 0.2497 | 0.0007 |
| 50000. | -30.00 | 135.0000 | 0.5669 | -0.4977 | 0.2705 | -0.0213 |
| 50000. | -30.00 | 150.0000 | 0.5605 | -0.4848 | 0.2780 | -0.0439 |
| 50000. | -30.00 | 165.0000 | 0.5376 | -0.4502 | 0.2866 | -0.0644 |
| 50000. | -30.00 | 180.0000 | 0.5039 | -0.4074 | 0.2869 | -0.0750 |
| 50000. | -30.00 | 195.0000 | 0.4677 | -0.3712 | 0.2742 | -0.0759 |
| 50000. | -30.00 | 210.0000 | 0.4446 | -0.3360 | 0.2811 | -0.0763 |
| 50000. | -30.00 | 225.0000 | 0.4132 | -0.2969 | 0.2776 | -0.0742 |
| 50000. | -30.00 | 240.0000 | 0.3847 | -0.2666 | 0.2676 | -0.0726 |
| 50000. | -30.00 | 255.0000 | 0.3574 | -0.2338 | 0.2591 | -0.0770 |
| 50000. | -30.00 | 270.0000 | 0.3208 | -0.1836 | 0.2523 | -0.0743 |
| 50000. | -30.00 | 285.0000 | 0.2813 | -0.1334 | 0.2424 | -0.0506 |
| 50000. | -30.00 | 300.0000 | 0.2495 | -0.1050 | 0.2263 | -0.0013 |
| 50000. | -30.00 | 315.0000 | 0.2395 | -0.1198 | 0.2019 | 0.0473 |
| 50000. | -30.00 | 330.0000 | 0.2507 | -0.1603 | 0.1743 | 0.0825 |
| 50000. | -30.00 | 345.0000 | 0.2799 | -0.2206 | 0.1479 | 0.0881 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 50000. | -20.00 | 0. | 0.3181 | -0.2607 | 0.1664 | 0.0741 |
| 50000. | -20.00 | 15.0000 | 0.3228 | -0.2783 | 0.1587 | 0.0398 |
| 50000. | -20.00 | 30.0000 | 0.3320 | -0.2812 | 0.1725 | 0.0372 |
| 50000. | -20.00 | 45.0000 | 0.3511 | -0.2889 | 0.1965 | 0.0346 |
| 50000. | -20.00 | 60.0000 | 0.3776 | -0.3069 | 0.2142 | 0.0496 |
| 50000. | -20.00 | 75.0000 | 0.4152 | -0.3350 | 0.2376 | 0.0610 |
| 50000. | -20.00 | 90.0000 | 0.4691 | -0.3877 | 0.2594 | 0.0492 |
| 50000. | -20.00 | 105.0000 | 0.5041 | -0.4100 | 0.2926 | 0.0176 |
| 50000. | -20.00 | 120.0000 | 0.5097 | -0.4000 | 0.3157 | -0.0119 |
| 50000. | -20.00 | 135.0000 | 0.5007 | -0.3829 | 0.3216 | -0.0269 |
| 50000. | -20.00 | 150.0000 | 0.4884 | -0.3622 | 0.3248 | -0.0439 |
| 50000. | -20.00 | 165.0000 | 0.4621 | -0.3281 | 0.3204 | -0.0572 |
| 50000. | -20.00 | 180.0000 | 0.4358 | -0.2902 | 0.3176 | -0.0691 |
| 50000. | -20.00 | 195.0000 | 0.4184 | -0.2587 | 0.3218 | -0.0675 |
| 50000. | -20.00 | 210.0000 | 0.3873 | -0.2216 | 0.3109 | -0.0653 |
| 50000. | -20.00 | 225.0000 | 0.3634 | -0.1940 | 0.3005 | -0.0639 |
| 50000. | -20.00 | 240.0000 | 0.3458 | -0.1715 | 0.2942 | -0.0601 |
| 50000. | -20.00 | 255.0000 | 0.3248 | -0.1426 | 0.2845 | -0.0651 |
| 50000. | -20.00 | 270.0000 | 0.2973 | -0.1032 | 0.2723 | -0.0600 |
| 50000. | -20.00 | 285.0000 | 0.2714 | -0.0625 | 0.2614 | -0.0378 |
| 50000. | -20.00 | 300.0000 | 0.2493 | -0.0471 | 0.2445 | 0.0125 |
| 50000. | -20.00 | 315.0000 | 0.2449 | -0.0701 | 0.2265 | 0.0615 |
| 50000. | -20.00 | 330.0000 | 0.2577 | -0.1244 | 0.2062 | 0.0917 |
| 50000. | -20.00 | 345.0000 | 0.2857 | -0.1971 | 0.1811 | 0.1001 |
| 50000. | -10.00 | 0. | 0.3176 | -0.2109 | 0.2270 | 0.0697 |
| 50000. | -10.00 | 15.0000 | 0.3362 | -0.2406 | 0.2316 | 0.0389 |
| 50000. | -10.00 | 30.0000 | 0.3405 | -0.2393 | 0.2413 | 0.0216 |
| 50000. | -10.00 | 45.0000 | 0.3473 | -0.2274 | 0.2618 | 0.0175 |
| 50000. | -10.00 | 60.0000 | 0.3695 | -0.2356 | 0.2824 | 0.0355 |
| 50000. | -10.00 | 75.0000 | 0.3979 | -0.2580 | 0.2997 | 0.0437 |
| 50000. | -10.00 | 90.0000 | 0.4367 | -0.2946 | 0.3208 | 0.0316 |
| 50000. | -10.00 | 105.0000 | 0.4470 | -0.2933 | 0.3373 | -0.0023 |
| 50000. | -10.00 | 120.0000 | 0.4444 | -0.2640 | 0.3567 | -0.0223 |
| 50000. | -10.00 | 135.0000 | 0.4378 | -0.2409 | 0.3646 | -0.0259 |
| 50000. | -10.00 | 150.0000 | 0.4253 | -0.2242 | 0.3594 | -0.0381 |
| 50000. | -10.00 | 165.0000 | 0.4096 | -0.1976 | 0.3548 | -0.0535 |
| 50000. | -10.00 | 180.0000 | 0.3894 | -0.1609 | 0.3492 | -0.0617 |
| 50000. | -10.00 | 195.0000 | 0.3622 | -0.1292 | 0.3333 | -0.0584 |
| 50000. | -10.00 | 210.0000 | 0.3446 | -0.1046 | 0.3235 | -0.0562 |
| 50000. | -10.00 | 225.0000 | 0.3300 | -0.0862 | 0.3140 | -0.0533 |
| 50000. | -10.00 | 240.0000 | 0.3162 | -0.0679 | 0.3043 | -0.0527 |
| 50000. | -10.00 | 255.0000 | 0.3093 | -0.0474 | 0.3004 | -0.0561 |
| 50000. | -10.00 | 270.0000 | 0.3015 | -0.0111 | 0.2966 | -0.0530 |
| 50000. | -10.00 | 285.0000 | 0.2896 | 0.0254 | 0.2871 | -0.0276 |
| 50000. | -10.00 | 300.0000 | 0.2782 | 0.0372 | 0.2746 | 0.0247 |
| 50000. | -10.00 | 315.0000 | 0.2637 | -0.0003 | 0.2539 | 0.0714 |
| 50000. | -10.00 | 330.0000 | 0.2620 | -0.0645 | 0.2328 | 0.1015 |
| 50000. | -10.00 | 345.0000 | 0.2899 | -0.1501 | 0.2246 | 0.1053 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 50000. | 0.00 | 0. | 0.3113 | -0.1296 | 0.2762 | 0.0618 |
| 50000. | 0.00 | 15.0000 | 0.3297 | -0.1425 | 0.2958 | 0.0301 |
| 50000. | 0.00 | 30.0000 | 0.3389 | -0.1395 | 0.3087 | 0.0111 |
| 50000. | 0.00 | 45.0000 | 0.3430 | -0.1204 | 0.3211 | 0.0066 |
| 50000. | 0.00 | 60.0000 | 0.3598 | -0.1132 | 0.3398 | 0.0213 |
| 50000. | 0.00 | 75.0000 | 0.3813 | -0.1339 | 0.3556 | 0.0312 |
| 50000. | 0.00 | 90.0000 | 0.4067 | -0.1596 | 0.3736 | 0.0194 |
| 50000. | 0.00 | 105.0000 | 0.4165 | -0.1501 | 0.3883 | -0.0106 |
| 50000. | 0.00 | 120.0000 | 0.4012 | -0.1168 | 0.3831 | -0.0236 |
| 50000. | 0.00 | 135.0000 | 0.3835 | -0.0951 | 0.3709 | -0.0216 |
| 50000. | 0.00 | 150.0000 | 0.3705 | -0.0823 | 0.3600 | -0.0305 |
| 50000. | 0.00 | 165.0000 | 0.3549 | -0.0594 | 0.3463 | -0.0497 |
| 50000. | 0.00 | 180.0000 | 0.3416 | -0.0251 | 0.3366 | -0.0530 |
| 50000. | 0.00 | 195.0000 | 0.3396 | 0.0011 | 0.3355 | -0.0524 |
| 50000. | 0.00 | 210.0000 | 0.3301 | 0.0155 | 0.3260 | -0.0492 |
| 50000. | 0.00 | 225.0000 | 0.3235 | 0.0270 | 0.3191 | -0.0461 |
| 50000. | 0.00 | 240.0000 | 0.3259 | 0.0387 | 0.3196 | -0.0509 |
| 50000. | 0.00 | 255.0000 | 0.3274 | 0.0626 | 0.3171 | -0.0524 |
| 50000. | 0.00 | 270.0000 | 0.3299 | 0.0983 | 0.3110 | -0.0490 |
| 50000. | 0.00 | 285.0000 | 0.3334 | 0.1362 | 0.3038 | -0.0183 |
| 50000. | 0.00 | 300.0000 | 0.3189 | 0.1376 | 0.2857 | 0.0342 |
| 50000. | 0.00 | 315.0000 | 0.3026 | 0.0931 | 0.2764 | 0.0803 |
| 50000. | 0.00 | 330.0000 | 0.2921 | 0.0171 | 0.2703 | 0.1093 |
| 50000. | 0.00 | 345.0000 | 0.2922 | -0.0727 | 0.2640 | 0.1020 |
| 50000. | 10.00 | 0. | 0.3202 | -0.0101 | 0.3164 | 0.0478 |
| 50000. | 10.00 | 15.0000 | 0.3319 | -0.0715 | 0.3311 | 0.0212 |
| 50000. | 10.00 | 30.0000 | 0.3440 | 0.0013 | 0.3440 | 0.0035 |
| 50000. | 10.00 | 45.0000 | 0.3519 | 0.0169 | 0.3515 | -0.0003 |
| 50000. | 10.00 | 60.0000 | 0.3662 | 0.0292 | 0.3649 | 0.0084 |
| 50000. | 10.00 | 75.0000 | 0.3853 | 0.0182 | 0.3844 | 0.0197 |
| 50000. | 10.00 | 90.0000 | 0.4017 | 0.0049 | 0.4015 | 0.0115 |
| 50000. | 10.00 | 105.0000 | 0.3966 | 0.0124 | 0.3963 | -0.0096 |
| 50000. | 10.00 | 120.0000 | 0.3878 | 0.0318 | 0.3863 | -0.0137 |
| 50000. | 10.00 | 135.0000 | 0.3720 | 0.0418 | 0.3695 | -0.0120 |
| 50000. | 10.00 | 150.0000 | 0.3508 | 0.0461 | 0.3471 | -0.0207 |
| 50000. | 10.00 | 165.0000 | 0.3412 | 0.0638 | 0.3327 | -0.0412 |
| 50000. | 10.00 | 180.0000 | 0.3324 | 0.0884 | 0.3171 | -0.0464 |
| 50000. | 10.00 | 195.0000 | 0.3279 | 0.1110 | 0.3045 | -0.0499 |
| 50000. | 10.00 | 210.0000 | 0.3357 | 0.1270 | 0.3070 | -0.0481 |
| 50000. | 10.00 | 225.0000 | 0.3460 | 0.1395 | 0.3128 | -0.0493 |
| 50000. | 10.00 | 240.0000 | 0.3569 | 0.1600 | 0.3149 | -0.0512 |
| 50000. | 10.00 | 255.0000 | 0.3696 | 0.1850 | 0.3157 | -0.0519 |
| 50000. | 10.00 | 270.0000 | 0.3855 | 0.2209 | 0.3126 | -0.0455 |
| 50000. | 10.00 | 285.0000 | 0.3932 | 0.2561 | 0.2982 | -0.0074 |
| 50000. | 10.00 | 300.0000 | 0.3772 | 0.2453 | 0.2833 | 0.0436 |
| 50000. | 10.00 | 315.0000 | 0.3510 | 0.1799 | 0.2762 | 0.0835 |
| 50000. | 10.00 | 330.0000 | 0.3243 | 0.1219 | 0.2789 | 0.1117 |
| 50000. | 10.00 | 345.0000 | 0.3116 | 0.0264 | 0.2952 | 0.0964 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 50000. | 20.00 | 0. | 0.3501 | 0.1254 | 0.3246 | 0.0392 |
| 50000. | 20.00 | 15.0000 | 0.3570 | 0.1293 | 0.3323 | 0.0179 |
| 50000. | 20.00 | 30.0000 | 0.3701 | 0.1460 | 0.3401 | -0.0048 |
| 50000. | 20.00 | 45.0000 | 0.3859 | 0.1628 | 0.3498 | -0.0085 |
| 50000. | 20.00 | 60.0000 | 0.4058 | 0.1811 | 0.3631 | -0.0010 |
| 50000. | 20.00 | 75.0000 | 0.4235 | 0.1840 | 0.3814 | 0.0059 |
| 50000. | 20.00 | 90.0000 | 0.4332 | 0.1809 | 0.3935 | 0.0068 |
| 50000. | 20.00 | 105.0000 | 0.4309 | 0.1755 | 0.3935 | -0.0025 |
| 50000. | 20.00 | 120.0000 | 0.4195 | 0.1859 | 0.3761 | -0.0007 |
| 50000. | 20.00 | 135.0000 | 0.3896 | 0.1736 | 0.3487 | 0.0051 |
| 50000. | 20.00 | 150.0000 | 0.3620 | 0.1562 | 0.3265 | -0.0062 |
| 50000. | 20.00 | 165.0000 | 0.3405 | 0.1594 | 0.2995 | -0.0293 |
| 50000. | 20.00 | 180.0000 | 0.3409 | 0.1806 | 0.2862 | -0.0415 |
| 50000. | 20.00 | 195.0000 | 0.3533 | 0.2037 | 0.2841 | -0.0512 |
| 50000. | 20.00 | 210.0000 | 0.3649 | 0.2233 | 0.2835 | -0.0541 |
| 50000. | 20.00 | 225.0000 | 0.3872 | 0.2489 | 0.2913 | -0.0555 |
| 50000. | 20.00 | 240.0000 | 0.4130 | 0.2769 | 0.3010 | -0.0573 |
| 50000. | 20.00 | 255.0000 | 0.4355 | 0.3080 | 0.3030 | -0.0546 |
| 50000. | 20.00 | 270.0000 | 0.4548 | 0.3475 | 0.2911 | -0.0371 |
| 50000. | 20.00 | 285.0000 | 0.4567 | 0.3682 | 0.2704 | 0.0059 |
| 50000. | 20.00 | 300.0000 | 0.4336 | 0.3450 | 0.2576 | 0.0520 |
| 50000. | 20.00 | 315.0000 | 0.3971 | 0.2905 | 0.2567 | 0.0859 |
| 50000. | 20.00 | 330.0000 | 0.3663 | 0.2219 | 0.2715 | 0.1059 |
| 50000. | 20.00 | 345.0000 | 0.3488 | 0.1521 | 0.3036 | 0.0797 |
| 50000. | 30.00 | 0. | 0.3955 | 0.2612 | 0.2954 | 0.0303 |
| 50000. | 30.00 | 15.0000 | 0.4009 | 0.2603 | 0.3046 | 0.0160 |
| 50000. | 30.00 | 30.0000 | 0.4142 | 0.2773 | 0.3075 | -0.0096 |
| 50000. | 30.00 | 45.0000 | 0.4346 | 0.2991 | 0.3148 | -0.0171 |
| 50000. | 30.00 | 60.0000 | 0.4578 | 0.3231 | 0.3240 | -0.0117 |
| 50000. | 30.00 | 75.0000 | 0.4708 | 0.3322 | 0.3336 | -0.0039 |
| 50000. | 30.00 | 90.0000 | 0.4817 | 0.3344 | 0.3467 | 0.0012 |
| 50000. | 30.00 | 105.0000 | 0.4827 | 0.3329 | 0.3496 | 0.0027 |
| 50000. | 30.00 | 120.0000 | 0.4679 | 0.3243 | 0.3370 | 0.0145 |
| 50000. | 30.00 | 135.0000 | 0.4420 | 0.2979 | 0.3258 | 0.0211 |
| 50000. | 30.00 | 150.0000 | 0.4057 | 0.2673 | 0.3050 | 0.0108 |
| 50000. | 30.00 | 165.0000 | 0.3795 | 0.2491 | 0.2860 | -0.0129 |
| 50000. | 30.00 | 180.0000 | 0.3694 | 0.2555 | 0.2642 | -0.0375 |
| 50000. | 30.00 | 195.0000 | 0.3843 | 0.2812 | 0.2564 | -0.0538 |
| 50000. | 30.00 | 210.0000 | 0.4071 | 0.3093 | 0.2575 | -0.0612 |
| 50000. | 30.00 | 225.0000 | 0.4392 | 0.3468 | 0.2608 | -0.0681 |
| 50000. | 30.00 | 240.0000 | 0.4711 | 0.3865 | 0.2618 | -0.0639 |
| 50000. | 30.00 | 255.0000 | 0.5032 | 0.4275 | 0.2598 | -0.0544 |
| 50000. | 30.00 | 270.0000 | 0.5187 | 0.4553 | 0.2471 | -0.0260 |
| 50000. | 30.00 | 285.0000 | 0.5148 | 0.4600 | 0.2305 | 0.0173 |
| 50000. | 30.00 | 300.0000 | 0.4895 | 0.4311 | 0.2239 | 0.0604 |
| 50000. | 30.00 | 315.0000 | 0.4518 | 0.3791 | 0.2299 | 0.0868 |
| 50000. | 30.00 | 330.0000 | 0.4079 | 0.3099 | 0.2494 | 0.0906 |
| 50000. | 30.00 | 345.0000 | 0.3985 | 0.2742 | 0.2809 | 0.0685 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 50000. | 40.00 | 0. | 0.4305 | 0.3550 | 0.2426 | 0.0280 |
| 50000. | 40.00 | 15.0000 | 0.4357 | 0.3579 | 0.2482 | 0.0092 |
| 50000. | 40.00 | 30.0000 | 0.4540 | 0.3763 | 0.2538 | -0.0106 |
| 50000. | 40.00 | 45.0000 | 0.4715 | 0.3970 | 0.2531 | -0.0243 |
| 50000. | 40.00 | 60.0000 | 0.4984 | 0.4248 | 0.2598 | -0.0230 |
| 50000. | 40.00 | 75.0000 | 0.5205 | 0.4426 | 0.2734 | -0.0145 |
| 50000. | 40.00 | 90.0000 | 0.5391 | 0.4584 | 0.2835 | -0.0106 |
| 50000. | 40.00 | 105.0000 | 0.5498 | 0.4650 | 0.2933 | 0.0067 |
| 50000. | 40.00 | 120.0000 | 0.5329 | 0.4460 | 0.2906 | 0.0246 |
| 50000. | 40.00 | 135.0000 | 0.4959 | 0.4087 | 0.2784 | 0.0371 |
| 50000. | 40.00 | 150.0000 | 0.4494 | 0.3600 | 0.2678 | 0.0266 |
| 50000. | 40.00 | 165.0000 | 0.4230 | 0.3360 | 0.2570 | -0.000[illegible] |
| 50000. | 40.00 | 180.0000 | 0.4144 | 0.3308 | 0.2474 | -0.0332 |
| 50000. | 40.00 | 195.0000 | 0.4337 | 0.3588 | 0.2376 | -0.0540 |
| 50000. | 40.00 | 210.0000 | 0.4592 | 0.3904 | 0.2315 | -0.0698 |
| 50000. | 40.00 | 225.0000 | 0.4937 | 0.4326 | 0.2260 | -0.0748 |
| 50000. | 40.00 | 240.0000 | 0.5289 | 0.4770 | 0.2178 | -0.0691 |
| 50000. | 40.00 | 255.0000 | 0.5616 | 0.5206 | 0.2042 | -0.0514 |
| 50000. | 40.00 | 270.0000 | 0.5743 | 0.5432 | 0.1858 | -0.0140 |
| 50000. | 40.00 | 285.0000 | 0.5615 | 0.5330 | 0.1747 | 0.0270 |
| 50000. | 40.00 | 300.0000 | 0.5284 | 0.4948 | 0.1725 | 0.0683 |
| 50000. | 40.00 | 315.0000 | 0.4939 | 0.4489 | 0.1894 | 0.0814 |
| 50000. | 40.00 | 330.0000 | 0.46[illegible]4 | 0.4001 | 0.2175 | 0.0740 |
| 50000. | 40.00 | 345.0000 | 0.4[illegible]05 | 0.3795 | 0.2333 | 0.0670 |
| | | | | | | |
| 50000. | 50.00 | 0. | 0.4657 | 0.4227 | 0.1934 | 0.0276 |
| 50000. | 50.00 | 15.0000 | 0.4725 | 0.4275 | 0.2010 | 0.0052 |
| 50000. | 50.00 | 30.0000 | 0.4817 | 0.4390 | 0.1979 | -0.0130 |
| 50000. | 50.00 | 45.0000 | 0.5039 | 0.4618 | 0.1995 | -0.0289 |
| 50000. | 50.00 | 60.0000 | 0.5332 | 0.4942 | 0.1970 | -0.0352 |
| 50000. | 50.00 | 75.0000 | 0.5580 | 0.5199 | 0.2010 | -0.0256 |
| 50000. | 50.00 | 90.0000 | 0.5783 | 0.5388 | 0.2091 | -0.0199 |
| 50000. | 50.00 | 105.0000 | 0.5868 | 0.5495 | 0.2060 | 0.0058 |
| 50000. | 50.00 | 120.0000 | 0.5754 | 0.5339 | 0.2131 | 0.0258 |
| 50000. | 50.00 | 135.0000 | 0.5525 | 0.5005 | 0.2300 | 0.0427 |
| 50000. | 50.00 | 150.0000 | 0.5151 | 0.4542 | 0.2406 | 0.0330 |
| 50000. | 50.00 | 165.0000 | 0.4934 | 0.4305 | 0.2409 | 0.0087 |
| 50000. | 50.00 | 180.0000 | 0.4730 | 0.4157 | 0.2246 | -0.0227 |
| 50000. | 50.00 | 195.0000 | 0.4807 | 0.4319 | 0.2047 | -0.0511 |
| 50000. | 50.00 | 210.0000 | 0.5033 | 0.4610 | 0.1880 | -0.0735 |
| 50000. | 50.00 | 225.0000 | 0.5416 | 0.5071 | 0.1742 | -0.0765 |
| 50000. | 50.00 | 240.0000 | 0.5733 | 0.5472 | 0.1568 | -0.0678 |
| 50000. | 50.00 | 255.0000 | 0.5947 | 0.5784 | 0.1333 | -0.0368 |
| 50000. | 50.00 | 270.0000 | 0.5902 | 0.5794 | 0.1120 | -0.0018 |
| 50000. | 50.00 | 285.0000 | 0.5815 | 0.5707 | 0.1073 | 0.0322 |
| 50000. | 50.00 | 300.0000 | 0.5559 | 0.5375 | 0.1252 | 0.0664 |
| 50000. | 50.00 | 315.0000 | 0.5226 | 0.4976 | 0.1400 | 0.0765 |
| 50000. | 50.00 | 330.0000 | 0.4910 | 0.4601 | 0.1549 | 0.0732 |
| 50000. | 50.00 | 345.0000 | 0.4694 | 0.4326 | 0.1734 | 0.0557 |

| (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 50000. | 60.00 | 0. | 0.4902 | 0.4677 | 0.1456 | 0.0237 |
| 50000. | 60.00 | 15.0000 | 0.4964 | 0.4738 | 0.1480 | 0.0044 |
| 50000. | 60.00 | 30.0000 | 0.5050 | 0.4827 | 0.1476 | -0.0139 |
| 50000. | 60.00 | 45.0000 | 0.5200 | 0.5007 | 0.1375 | -0.0277 |
| 50000. | 60.00 | 60.0000 | 0.5344 | 0.5171 | 0.1294 | -0.0386 |
| 50000. | 60.00 | 75.0000 | 0.5703 | 0.5532 | 0.1300 | -0.0476 |
| 50000. | 60.00 | 90.0000 | 0.6076 | 0.5919 | 0.1339 | -0.0286 |
| 50000. | 60.00 | 105.0000 | 0.6116 | 0.5941 | 0.1451 | -0.0003 |
| 50000. | 60.00 | 120.0000 | 0.6132 | 0.5922 | 0.1584 | 0.0145 |
| 50000. | 60.[illegible] | 135.0000 | 0.5978 | 0.5733 | 0.1647 | 0.0403 |
| 50000. | 60.00 | 150.0000 | 0.5600 | 0.5322 | 0.1707 | 0.0334 |
| 50000. | 60.00 | 165.0000 | 0.5412 | 0.5121 | 0.1747 | 0.0144 |
| 50000. | 60.00 | 180.0000 | 0.5227 | 0.4912 | 0.1784 | -0.0122 |
| 50000. | 60.00 | 195.0000 | 0.5284 | 0.4987 | 0.1688 | -0.0453 |
| 50000. | 60.00 | 210.0000 | 0.5459 | 0.5211 | 0.1489 | -0.0653 |
| 50000. | 60.00 | 225.0000 | 0.5729 | 0.5560 | 0.1193 | -0.0699 |
| 50000. | 60.00 | 240.0000 | 0.5923 | 0.5826 | [illegible]922 | -0.0538 |
| 50000. | 60.00 | 255.0000 | 0.6025 | 0.5975 | [illegible]741 | -0.0233 |
| 50000. | 60.00 | 270.0000 | 0.5883 | 0.5843 | .0665 | 0.0158 |
| 50000. | 60.00 | 285.0000 | 0.5659 | 0.5614 | 0.0630 | 0.0341 |
| 50000. | 60.00 | 300.0000 | 0.5619 | 0.5546 | 0.0709 | 0.0558 |
| 50000. | 60.00 | 315.0000 | 0.5355 | 0.5218 | 0.0920 | 0.0773 |
| 50000. | 60.00 | 330.0000 | 0.5045 | 0.4865 | 0.1161 | 0.0662 |
| 50000. | 60.00 | 345.0000 | 0.4938 | 0.4725 | 0.1358 | 0.0466 |
| 50000. | 70.00 | 0. | 0.5128 | 0.5013 | 0.1059 | 0.0219 |
| 50000. | 70.00 | 15.0000 | 0.5168 | 0.5050 | 0.1097 | 0.0053 |
| 50000. | 70.00 | 30.0000 | 0.5195 | 0.5082 | 0.1074 | -0.0078 |
| 50000. | 70.00 | 45.0000 | 0.5216 | 0.5110 | 0.1023 | -0.0234 |
| 50000. | 70.00 | 60.0000 | 0.5353 | 0.5252 | 0.0940 | -0.0437 |
| 50000. | 70.00 | 75.0000 | 0.5651 | 0.5568 | 0.0798 | -0.0546 |
| 50000. | 70.00 | 90.0000 | 0.5962 | 0.5905 | 0.0684 | -0.0450 |
| 50000. | 70.00 | 105.0000 | 0.6199 | 0.6157 | 0.0679 | -0.0249 |
| 50000. | 70.00 | 120.0000 | 0.6321 | 0.6277 | 0.0745 | 0.0037 |
| 50000. | 70.00 | 135.0000 | 0.6182 | 0.6106 | 0.0918 | 0.0311 |
| 50000. | 70.00 | 150.0000 | 0.5908 | 0.5792 | 0.1127 | 0.0296 |
| 50000. | 70.00 | 165.0000 | 0.5751 | 0.5620 | 0.1218 | 0.0103 |
| 50000. | 70.00 | 180.0000 | 0.5680 | 0.5551 | 0.1197 | -0.0103 |
| 50000. | 70.00 | 195.0000 | 0.5656 | 0.5547 | 0.1061 | -0.0305 |
| 50000. | 70.00 | 210.0000 | 0.5689 | 0.5607 | 0.0849 | -0.0446 |
| 50000. | 70.00 | 225.0000 | 0.5776 | 0.5722 | 0.0616 | -0.0484 |
| 50000. | 70.00 | 240.0000 | 0.5895 | 0.5867 | 0.0406 | -0.0394 |
| 50000. | 70.00 | 255.0000 | 0.6001 | 0.5994 | 0.0251 | -0.0153 |
| 50000. | 70.00 | 270.0000 | 0.5965 | 0.5957 | 0.0224 | 0.0195 |
| 50000. | 70.00 | 285.0000 | 0.5781 | 0.5756 | 0.0304 | 0.0439 |
| 50000. | 70.00 | 300.0000 | 0.5591 | 0.5545 | 0.0410 | 0.0589 |
| 50000. | 70.00 | 315.0000 | 0.5379 | 0.5305 | 0.0590 | 0.0666 |
| 50000. | 70.00 | 330.0000 | 0.5197 | 0.5104 | 0.0795 | 0.0571 |
| 50000. | 70.00 | 345.0000 | 0.5127 | 0.5023 | 0.0949 | 0.0400 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 50000. | 80.00 | 0. | 0.5339 | 0.5287 | 0.0722 | 0.0190 |
| 50000. | 80.00 | 15.0000 | 0.5365 | 0.5311 | 0.0759 | 0.0049 |
| 50000. | 80.00 | 30.0000 | 0.5398 | 0.5343 | 0.0762 | -0.0090 |
| 50000. | 80.00 | 45.0000 | 0.5447 | 0.5394 | 0.0724 | -0.0236 |
| 50000. | 80.00 | 60.0000 | 0.5529 | 0.5481 | 0.0631 | -0.0369 |
| 50000. | 80.00 | 75.0000 | 0.5646 | 0.5607 | 0.0489 | -0.0446 |
| 50000. | 80.00 | 90.0000 | 0.5780 | 0.5754 | 0.0337 | -0.0434 |
| 50000. | 80.00 | 105.0000 | 0.5901 | 0.5887 | 0.0219 | -0.0334 |
| 50000. | 80.00 | 120.0000 | 0.5977 | 0.5972 | 0.0175 | -0.0179 |
| 50000. | 80.00 | 135.0000 | 0.5991 | 0.5987 | 0.0215 | -0.0034 |
| 50000. | 80.00 | 150.0000 | 0.5951 | 0.5943 | 0.0302 | 0.0041 |
| 50000. | 80.00 | 165.0000 | 0.5883 | 0.5870 | 0.0379 | 0.0031 |
| 50000. | 80.00 | 180.0000 | 0.5811 | 0.5797 | 0.0408 | -0.0036 |
| 50000. | 80.00 | 195.0000 | 0.5758 | 0.5744 | 0.0374 | -0.0127 |
| 50000. | 80.00 | 210.0000 | 0.5736 | 0.5726 | 0.0278 | -0.0197 |
| 50000. | 80.00 | 225.0000 | 0.5742 | 0.5737 | 0.0139 | -0.0200 |
| 50000. | 80.00 | 240.0000 | 0.5750 | 0.5749 | 0.0002 | -0.0115 |
| 50000. | 80.00 | 255.0000 | 0.5735 | 0.5734 | -0.0086 | 0.0045 |
| 50000. | 80.00 | 270.0000 | 0.5686 | 0.5681 | -0.0089 | 0.0234 |
| 50000. | 80.00 | 285.0000 | 0.5609 | 0.5595 | -0.0003 | 0.0398 |
| 50000. | 80.00 | 300.0000 | 0.5518 | 0.5494 | 0.0148 | 0.0499 |
| 50000. | 80.00 | 315.0000 | 0.5431 | 0.5396 | 0.0331 | 0.0520 |
| 50000. | 80.00 | 330.0000 | 0.5364 | 0.5321 | 0.0507 | 0.0457 |
| 50000. | 80.00 | 345.0000 | 0.5334 | 0.5285 | 0.0641 | 0.0334 |
| 50000. | 90.00 | 0. | 0.5646 | 0.5636 | 0 | 0 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 100000. | -90.00 | 0. | 0.5557 | -0.5361 | 0 | 0 |
| 100000. | -80.00 | 0. | 0.5173 | -0.4914 | 0.1417 | 0.0780 |
| 100000. | -80.00 | 15.0000 | 0.5242 | -0.5010 | 0.1186 | 0.0984 |
| 100000. | -80.00 | 30.0000 | 0.5305 | -0.5107 | 0.0914 | 0.1108 |
| 100000. | -80.00 | 45.0000 | 0.5354 | -0.5185 | 0.0639 | 0.1171 |
| 100000. | -80.00 | 60.0000 | 0.5406 | -0.5256 | 0.0366 | 0.1209 |
| 100000. | -80.00 | 75.0000 | 0.5484 | -0.5346 | 0.0070 | 0.1220 |
| 100000. | -80.00 | 90.0000 | 0.5593 | -0.5465 | -0.0237 | 0.1164 |
| 100000. | -80.00 | 105.0000 | 0.5724 | -0.5608 | -0.0507 | 0.1032 |
| 100000. | -80.00 | 120.0000 | 0.5897 | -0.5790 | -0.0717 | 0.0854 |
| 100000. | -80.00 | 135.0000 | 0.6130 | -0.6033 | -0.0894 | 0.0620 |
| 100000. | -80.00 | 150.0000 | 0.6388 | -0.6296 | -0.1051 | 0.0257 |
| 100000. | -80.00 | 165.0000 | 0.6561 | -0.6458 | -0.1127 | -0.0276 |
| 100000. | -80.00 | 180.0000 | 0.6544 | -0.6401 | -0.1030 | -0.0890 |
| 100000. | -80.00 | 195.0000 | 0.6318 | -0.6116 | -0.0736 | -0.1403 |
| 100000. | -80.00 | 210.0000 | 0.5961 | -0.5710 | -0.0313 | -0.1683 |
| 100000. | -80.00 | 225.0000 | 0.5593 | -0.5322 | 0.0146 | -0.1715 |
| 100000. | -80.00 | 240.0000 | 0.5309 | -0.5038 | 0.0572 | -0.1572 |
| 100000. | -80.00 | 255.0000 | 0.5134 | -0.4866 | 0.0940 | -0.1339 |
| 100000. | -80.00 | 270.0000 | 0.5040 | -0.4768 | 0.1244 | -0.1057 |
| 100000. | -80.00 | 285.0000 | 0.4998 | -0.4719 | 0.1472 | -0.0736 |
| 100000. | -80.00 | 300.0000 | 0.4994 | -0.4711 | 0.1608 | -0.0398 |
| 100000. | -80.00 | 315.0000 | 0.5019 | -0.4736 | 0.1659 | -0.0074 |
| 100000. | -80.00 | 330.0000 | 0.5060 | -0.4778 | 0.1648 | 0.0229 |
| 100000. | -80.00 | 345.0000 | 0.5111 | -0.4836 | 0.1572 | 0.0517 |
| 100000. | -70.00 | 0. | 0.4458 | -0.4033 | 0.1749 | 0.0741 |
| 100000. | -70.00 | 15.0000 | 0.4653 | -0.4259 | 0.1587 | 0.0996 |
| 100000. | -70.00 | 30.0000 | 0.4936 | -0.4609 | 0.1353 | 0.1134 |
| 100000. | -70.00 | 45.0000 | 0.5101 | -0.4864 | 0.1079 | 0.1092 |
| 100000. | -70.00 | 60.0000 | 0.5135 | -0.4942 | 0.0844 | 0.1109 |
| 100000. | -70.00 | 75.0000 | 0.5364 | -0.5176 | 0.0576 | 0.1283 |
| 100000. | -70.00 | 90.0000 | 0.5829 | -0.5678 | 0.0227 | 0.1298 |
| 100000. | -70.00 | 105.0000 | 0.6207 | -0.6123 | -0.0106 | 0.1011 |
| 100000. | -70.00 | 120.0000 | 0.6340 | -0.6303 | -0.0295 | 0.0613 |
| 100000. | -70.00 | 135.0000 | 0.6356 | -0.6341 | -0.0287 | 0.0334 |
| 100000. | -70.00 | 150.0000 | 0.6523 | -0.6517 | -0.0188 | 0.0178 |
| 100000. | -70.00 | 165.0000 | 0.6868 | -0.6865 | -0.0118 | -0.0160 |
| 100000. | -70.00 | 180.0000 | 0.7022 | -0.6982 | 0.0032 | -0.0756 |
| 100000. | -70.00 | 195.0000 | 0.6837 | -0.6723 | 0.0263 | -0.1214 |
| 100000. | -70.00 | 210.0000 | 0.6482 | -0.6304 | 0.0441 | -0.1443 |
| 100000. | -70.00 | 225.0000 | 0.6018 | -0.5785 | 0.0610 | -0.1544 |
| 100000. | -70.00 | 240.0000 | 0.5521 | -0.5244 | 0.0841 | -0.1507 |
| 100000. | -70.00 | 255.0000 | 0.5114 | -0.4793 | 0.1142 | -0.1371 |
| 100000. | -70.00 | 270.0000 | 0.4792 | -0.4412 | 0.1476 | -0.1151 |
| 100000. | -70.00 | 285.0000 | 0.4573 | -0.4144 | 0.1770 | -0.0776 |
| 100000. | -70.00 | 300.0000 | 0.4546 | -0.4100 | 0.1930 | -0.0363 |
| 100000. | -70.00 | 315.0000 | 0.4572 | -0.4119 | 0.1982 | -0.0090 |
| 100000. | -70.00 | 330.0000 | 0.4493 | -0.4033 | 0.1975 | 0.0142 |
| 100000. | -70.00 | 345.0000 | 0.4412 | -0.3961 | 0.1892 | 0.0442 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 100000. | -60.00 | 0. | 0.3778 | -0.3345 | 0.1605 | 0.0713 |
| 100000. | -60.00 | 15.0000 | 0.3863 | -0.3477 | 0.1477 | 0.0806 |
| 100000. | -60.00 | 30.0000 | 0.4102 | -0.3719 | 0.1429 | 0.0977 |
| 100000. | -60.00 | 45.0000 | 0.4478 | -0.4135 | 0.1341 | 0.1078 |
| 100000. | -60.00 | 60.0000 | 0.4774 | -0.4530 | 0.1116 | 0.1098 |
| 100000. | -60.00 | 75.0000 | 0.5102 | -0.4882 | 0.0908 | 0.1169 |
| 100000. | -60.00 | 90.0000 | 0.5545 | -0.5365 | 0.0804 | 0.1145 |
| 100000. | -60.00 | 105.0000 | 0.6019 | -0.5897 | 0.0688 | 0.0988 |
| 100000. | -60.00 | 120.0000 | 0.6392 | -0.6340 | 0.0551 | 0.0601 |
| 100000. | -60.00 | 135.0000 | 0.6588 | -0.6566 | 0.0478 | 0.0229 |
| 100000. | -60.00 | 150.0000 | 0.6739 | -0.6713 | 0.0585 | -0.0041 |
| 100000. | -60.00 | 165.0000 | 0.7055 | -0.6997 | 0.0833 | -0.0354 |
| 100000. | -60.00 | 180.0000 | 0.6944 | -0.6779 | 0.1139 | -0.0985 |
| 100000. | -60.00 | 195.0000 | 0.6364 | -0.6087 | 0.1411 | -0.1209 |
| 100000. | -60.00 | 210.0000 | 0.5934 | -0.5587 | 0.1616 | -0.1177 |
| 100000. | -60.00 | 225.0000 | 0.5655 | -0.5291 | 0.1674 | -0.1088 |
| 100000. | -60.00 | 240.0000 | 0.5430 | -0.5066 | 0.1614 | -0.1151 |
| 100000. | -60.00 | 255.0000 | 0.5065 | -0.4609 | 0.1699 | -0.1238 |
| 100000. | -60.00 | 270.0000 | 0.4615 | -0.4061 | 0.1868 | -0.1146 |
| 100000. | -60.00 | 285.0000 | 0.4179 | -0.3526 | 0.2070 | -0.0860 |
| 100000. | -60.00 | 300.0000 | 0.3929 | -0.3201 | 0.2238 | -0.0421 |
| 100000. | -60.00 | 315.0000 | 0.3785 | -0.3052 | 0.2238 | -0.0010 |
| 100000. | -60.00 | 330.0000 | 0.3683 | -0.3057 | 0.2030 | 0.0312 |
| 100000. | -60.00 | 345.0000 | 0.3669 | -0.3145 | 0.1804 | 0.0561 |
| 100000. | -50.00 | 0. | 0.3251 | -0.2824 | 0.1441 | 0.0717 |
| 100000. | -50.00 | 15.0000 | 0.3448 | -0.3094 | 0.1323 | 0.0753 |
| 100000. | -50.00 | 30.0000 | 0.3690 | -0.3369 | 0.1298 | 0.0764 |
| 100000. | -50.00 | 45.0000 | 0.3946 | -0.3612 | 0.1317 | 0.0888 |
| 100000. | -50.00 | 60.0000 | 0.4334 | -0.4012 | 0.1289 | 0.1012 |
| 100000. | -50.00 | 75.0000 | 0.4802 | -0.4537 | 0.1135 | 0.1091 |
| 100000. | -50.00 | 90.0000 | 0.5259 | -0.5069 | 0.0978 | 0.1001 |
| 100000. | -50.00 | 105.0000 | 0.5819 | -0.5678 | 0.0933 | 0.0867 |
| 100000. | -50.00 | 120.0000 | 0.6248 | -0.6150 | 0.1020 | 0.0420 |
| 100000. | -50.00 | 135.0000 | 0.6470 | -0.6359 | 0.1191 | 0.0064 |
| 100000. | -50.00 | 150.0000 | 0.6363 | -0.6174 | 0.1487 | -0.0406 |
| 100000. | -50.00 | 165.0000 | 0.6261 | -0.5984 | 0.1760 | -0.0543 |
| 100000. | -50.00 | 180.0000 | 0.6056 | -0.5692 | 0.1876 | -0.0868 |
| 100000. | -50.00 | 195.0000 | 0.5730 | -0.5326 | 0.1867 | -0.0969 |
| 100000. | -50.00 | 210.0000 | 0.5285 | -0.4843 | 0.1852 | -0.1026 |
| 100000. | -50.00 | 225.0000 | 0.4951 | -0.4475 | 0.1915 | -0.0908 |
| 100000. | -50.00 | 240.0000 | 0.4849 | -0.4294 | 0.2045 | -0.0944 |
| 100000. | -50.00 | 255.0000 | 0.4523 | -0.3858 | 0.2100 | -0.1077 |
| 100000. | -50.00 | 270.0000 | 0.4083 | -0.3291 | 0.2189 | -0.1027 |
| 100000. | -50.00 | 285.0000 | 0.3606 | -0.2670 | 0.2285 | -0.0806 |
| 100000. | -50.00 | 300.0000 | 0.3228 | -0.2275 | 0.2270 | -0.0301 |
| 100000. | -50.00 | 315.0000 | 0.3057 | -0.2228 | 0.2084 | 0.0186 |
| 100000. | -50.00 | 330.0000 | 0.3085 | -0.2411 | 0.1864 | 0.0483 |
| 100000. | -50.00 | 345.0000 | 0.3114 | -0.2583 | 0.1613 | 0.0649 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 100000. | -40.00 | 0. | 0.2964 | -0.2580 | 0.1273 | 0.0714 |
| 100000. | -40.00 | 15.0000 | 0.3206 | -0.2880 | 0.1270 | 0.0609 |
| 100000. | -40.00 | 30.0000 | 0.3319 | -0.2971 | 0.1344 | 0.0616 |
| 100000. | -40.00 | 45.0000 | 0.3602 | -0.3257 | 0.1351 | 0.0735 |
| 100000. | -40.00 | 60.0000 | 0.4019 | -0.3653 | 0.1429 | 0.0879 |
| 100000. | -40.00 | 75.0000 | 0.4657 | -0.4308 | 0.1463 | 0.0995 |
| 100000. | -40.00 | 90.0000 | 0.5262 | -0.4971 | 0.1480 | 0.0889 |
| 100000. | -40.00 | 105.0000 | 0.5737 | -0.5482 | 0.1578 | 0.0607 |
| 100000. | -40.00 | 120.0000 | 0.6057 | -0.5802 | 0.1724 | 0.0235 |
| 100000. | -40.00 | 135.0000 | 0.6178 | -0.5874 | 0.1912 | -0.0111 |
| 100000. | -40.00 | 150.0000 | 0.5979 | -0.5627 | 0.1968 | -0.0460 |
| 100000. | -40.00 | 165.0000 | 0.5837 | -0.5422 | 0.2075 | -0.0603 |
| 100000. | -40.00 | 180.0000 | 0.5561 | -0.5028 | 0.2225 | -0.0834 |
| 100000. | -40.00 | 195.0000 | 0.5125 | -0.4475 | 0.2339 | -0.0877 |
| 100000. | -40.00 | 210.0000 | 0.4883 | -0.4229 | 0.2306 | -0.0805 |
| 100000. | -40.00 | 225.0000 | 0.4639 | -0.3917 | 0.2339 | -0.0844 |
| 100000. | -40.00 | 240.0000 | 0.4364 | -0.3552 | 0.2387 | -0.0858 |
| 100000. | -40.00 | 255.0000 | 0.4040 | -0.3131 | 0.2384 | -0.0916 |
| 100000. | -40.00 | 270.0000 | 0.3582 | -0.2555 | 0.2347 | -0.0894 |
| 100000. | -40.00 | 285.0000 | 0.3068 | -0.1957 | 0.2268 | -0.0662 |
| 100000. | -40.00 | 300.0000 | 0.2683 | -0.1570 | 0.2170 | -0.0158 |
| 100000. | -40.00 | 315.0000 | 0.2606 | -0.1613 | 0.2020 | 0.0330 |
| 100000. | -40.00 | 330.0000 | 0.2662 | -0.1882 | 0.1764 | 0.0656 |
| 100000. | -40.00 | 345.0000 | 0.2806 | -0.2277 | 0.1452 | 0.0762 |
| 100000. | -30.00 | 0. | 0.2983 | -0.2614 | 0.1255 | 0.0699 |
| 100000. | -30.00 | 15.0000 | 0.3023 | -0.2700 | 0.1283 | 0.0453 |
| 100000. | -30.00 | 30.0000 | 0.3184 | -0.2834 | 0.1337 | 0.0562 |
| 100000. | -30.00 | 45.0000 | 0.3507 | -0.3129 | 0.1501 | 0.0505 |
| 100000. | -30.00 | 60.0000 | 0.3819 | -0.3358 | 0.1679 | 0.0700 |
| 100000. | -30.00 | 75.0000 | 0.4385 | -0.3887 | 0.1860 | 0.0810 |
| 100000. | -30.00 | 90.0000 | 0.4961 | -0.4490 | 0.1998 | 0.0680 |
| 100000. | -30.00 | 105.0000 | 0.5418 | -0.4939 | 0.2186 | 0.0435 |
| 100000. | -30.00 | 120.0000 | 0.5674 | -0.5104 | 0.2478 | 0.0008 |
| 100000. | -30.00 | 135.0000 | 0.5626 | -0.4940 | 0.2684 | -0.0211 |
| 100000. | -30.00 | 150.0000 | 0.5560 | -0.4809 | 0.2757 | -0.0436 |
| 100000. | -30.00 | 165.0000 | 0.5334 | -0.4468 | 0.2842 | -0.0639 |
| 100000. | -30.00 | 180.0000 | 0.5001 | -0.4044 | 0.2846 | -0.0744 |
| 100000. | -30.00 | 195.0000 | 0.4643 | -0.3683 | 0.2724 | -0.0754 |
| 100000. | -30.00 | 210.0000 | 0.4412 | -0.3334 | 0.2789 | -0.0757 |
| 100000. | -30.00 | 225.0000 | 0.4102 | -0.2948 | 0.2755 | -0.0737 |
| 100000. | -30.00 | 240.0000 | 0.3820 | -0.2647 | 0.2658 | -0.0721 |
| 100000. | -30.00 | 255.0000 | 0.3548 | -0.2319 | 0.2575 | -0.0764 |
| 100000. | -30.00 | 270.0000 | 0.3186 | -0.1823 | 0.2507 | -0.0736 |
| 100000. | -30.00 | 285.0000 | 0.2795 | -0.1326 | 0.2409 | -0.0500 |
| 100000. | -30.00 | 300.0000 | 0.2481 | -0.1046 | 0.2250 | -0.0013 |
| 100000. | -30.00 | 315.0000 | 0.2383 | -0.1192 | 0.2009 | 0.0470 |
| 100000. | -30.00 | 330.0000 | 0.2494 | -0.1593 | 0.1736 | 0.0817 |
| 100000. | -30.00 | 345.0000 | 0.2781 | -0.2189 | 0.1475 | 0.0874 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 100000. | -20.00 | 0. | 0.3155 | -0.2582 | 0.1657 | 0.0735 |
| 100000. | -20.00 | 15.0000 | 0.3205 | -0.2758 | 0.1562 | 0.0398 |
| 100000. | -20.00 | 30.0000 | 0.3297 | -0.2790 | 0.1718 | 0.0370 |
| 100000. | -20.00 | 45.0000 | 0.3486 | -0.2866 | 0.1955 | 0.0345 |
| 100000. | -20.00 | 60.0000 | 0.3749 | -0.3045 | 0.2131 | 0.0493 |
| 100000. | -20.00 | 75.0000 | 0.4124 | -0.3326 | 0.2362 | 0.0604 |
| 100000. | -20.00 | 90.0000 | 0.4655 | -0.3846 | 0.2577 | 0.0487 |
| 100000. | -20.00 | 105.0000 | 0.5000 | -0.4067 | 0.2903 | 0.0174 |
| 100000. | -20.00 | 120.0000 | 0.5057 | -0.3969 | 0.3131 | -0.0117 |
| 100000. | -20.00 | 135.0000 | 0.4969 | -0.3799 | 0.3192 | -0.0267 |
| 100000. | -20.00 | 150.0000 | 0.4847 | -0.3594 | 0.3223 | -0.0435 |
| 100000. | -20.00 | 165.0000 | 0.4588 | -0.3257 | 0.3181 | -0.0568 |
| 100000. | -20.00 | 180.0000 | 0.4327 | -0.2882 | 0.3154 | -0.0685 |
| 100000. | -20.00 | 195.0000 | 0.4151 | -0.2568 | 0.3191 | -0.0670 |
| 100000. | -20.00 | 210.0000 | 0.3845 | -0.2200 | 0.3086 | -0.0649 |
| 100000. | -20.00 | 225.0000 | 0.3608 | -0.1926 | 0.2984 | -0.0635 |
| 100000. | -20.00 | 240.0000 | 0.3432 | -0.1701 | 0.2920 | -0.0598 |
| 100000. | -20.00 | 255.0000 | 0.3224 | -0.1415 | 0.2824 | -0.0646 |
| 100000. | -20.00 | 270.0000 | 0.2953 | -0.1023 | 0.2706 | -0.0595 |
| 100000. | -20.00 | 285.0000 | 0.2696 | -0.0621 | 0.2597 | -0.0373 |
| 100000. | -20.00 | 300.0000 | 0.2479 | -0.0468 | 0.2431 | 0.0124 |
| 100000. | -20.00 | 315.0000 | 0.2434 | -0.0696 | 0.2251 | 0.0610 |
| 100000. | -20.00 | 330.0000 | 0.2559 | -0.1234 | 0.2049 | 0.0909 |
| 100000. | -20.00 | 345.0000 | 0.2836 | -0.1954 | 0.1802 | 0.0991 |
| 100000. | -10.00 | 0. | 0.3149 | -0.2088 | 0.2254 | 0.0692 |
| 100000. | -10.00 | 15.0000 | 0.3333 | -0.2381 | 0.2300 | 0.0387 |
| 100000. | -10.00 | 30.0000 | 0.3378 | -0.2369 | 0.2398 | 0.0215 |
| 100000. | -10.00 | 45.0000 | 0.3446 | -0.2255 | 0.2601 | 0.0176 |
| 100000. | -10.00 | 60.0000 | 0.3666 | -0.2336 | 0.2804 | 0.0352 |
| 100000. | -10.00 | 75.0000 | 0.3948 | -0.2558 | 0.2976 | 0.0433 |
| 100000. | -10.00 | 90.0000 | 0.4331 | -0.2919 | 0.3184 | 0.0313 |
| 100000. | -10.00 | 105.0000 | 0.4436 | -0.2908 | 0.3349 | -0.0021 |
| 100000. | -10.00 | 120.0000 | 0.4410 | -0.2621 | 0.3540 | -0.0220 |
| 100000. | -10.00 | 135.0000 | 0.4344 | -0.2392 | 0.3617 | -0.0257 |
| 100000. | -10.00 | 150.0000 | 0.4220 | -0.2226 | 0.3565 | -0.0378 |
| 100000. | -10.00 | 165.0000 | 0.4064 | -0.1961 | 0.3519 | -0.0531 |
| 100000. | -10.00 | 180.0000 | 0.3863 | -0.1598 | 0.3463 | -0.0612 |
| 100000. | -10.00 | 195.0000 | 0.3597 | -0.1284 | 0.3309 | -0.0581 |
| 100000. | -10.00 | 210.0000 | 0.3422 | -0.1039 | 0.3212 | -0.0559 |
| 100000. | -10.00 | 225.0000 | 0.3276 | -0.0855 | 0.3118 | -0.0530 |
| 100000. | -10.00 | 240.0000 | 0.3141 | -0.0673 | 0.3023 | -0.0524 |
| 100000. | -10.00 | 255.0000 | 0.3071 | -0.0467 | 0.2983 | -0.0558 |
| 100000. | -10.00 | 270.0000 | 0.2993 | -0.0108 | 0.2944 | -0.0525 |
| 100000. | -10.00 | 285.0000 | 0.2875 | 0.0253 | 0.2851 | -0.0272 |
| 100000. | -10.00 | 300.0000 | 0.2762 | 0.0369 | 0.2726 | 0.0245 |
| 100000. | -10.00 | 315.0000 | 0.2619 | -0.0001 | 0.2522 | 0.0708 |
| 100000. | -10.00 | 330.0000 | 0.2603 | -0.0638 | 0.2314 | 0.1006 |
| 100000. | -10.00 | 345.0000 | 0.2876 | -0.1485 | 0.2232 | 0.1042 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 100000. | 0.00 | 0. | 0.3088 | -0.1279 | 0.2742 | 0.0514 |
| 100000. | 0.00 | 15.0000 | 0.3269 | -0.1409 | 0.2935 | 0.0300 |
| 100000. | 0.00 | 30.0000 | 0.3361 | -0.1380 | 0.3063 | 0.0112 |
| 100000. | 0.00 | 45.0000 | 0.3402 | -0.1192 | 0.3186 | 0.0067 |
| 100000. | 0.00 | 60.0000 | 0.3569 | -0.1152 | 0.3371 | 0.0212 |
| 100000. | 0.00 | 75.0000 | 0.3783 | -0.1327 | 0.3529 | 0.0309 |
| 100000. | 0.00 | 90.0000 | 0.4034 | -0.1580 | 0.3706 | 0.0193 |
| 100000. | 0.00 | 105.0000 | 0.4130 | -0.1487 | 0.3851 | -0.0104 |
| 100000. | 0.00 | 120.0000 | 0.3981 | -0.1160 | 0.3801 | -0.0232 |
| 100000. | 0.00 | 135.0000 | 0.3807 | -0.0947 | 0.3681 | -0.0214 |
| 100000. | 0.00 | 150.0000 | 0.3679 | -0.0819 | 0.3573 | -0.0303 |
| 100000. | 0.00 | 165.0000 | 0.3524 | -0.0591 | 0.3439 | -0.0493 |
| 100000. | 0.00 | 180.0000 | 0.3392 | -0.0252 | 0.3342 | -0.0526 |
| 100000. | 0.00 | 195.0000 | 0.3369 | 0.0008 | 0.3328 | -0.0521 |
| 100000. | 0.00 | 210.0000 | 0.3276 | 0.0153 | 0.3236 | -0.0489 |
| 100000. | 0.00 | 225.0000 | 0.3212 | 0.0268 | 0.3168 | -0.0459 |
| 100000. | 0.00 | 240.0000 | 0.3235 | 0.0387 | 0.3172 | -0.0506 |
| 100000. | 0.00 | 255.0000 | 0.3250 | 0.0624 | 0.3147 | -0.0520 |
| 100000. | 0.00 | 270.0000 | 0.3275 | 0.0978 | 0.3087 | -0.0485 |
| 100000. | 0.00 | 285.0000 | 0.3309 | 0.1352 | 0.3014 | -0.0181 |
| 100000. | 0.00 | 300.0000 | 0.3166 | 0.1366 | 0.2836 | 0.0339 |
| 100000. | 0.00 | 315.0000 | 0.3003 | 0.0925 | 0.2744 | 0.0796 |
| 100000. | 0.00 | 330.0000 | 0.2897 | 0.0172 | 0.2682 | 0.1082 |
| 100000. | 0.00 | 345.0000 | 0.2900 | -0.0717 | 0.2622 | 0.1010 |
| 100000. | 10.00 | 0. | 0.3176 | -0.0096 | 0.3139 | 0.0477 |
| 100000. | 10.00 | 15.0000 | 0.3292 | -0.0111 | 0.3284 | 0.0212 |
| 100000. | 10.00 | 30.0000 | 0.3411 | 0.0014 | 0.3411 | 0.0037 |
| 100000. | 10.00 | 45.0000 | 0.3491 | 0.0169 | 0.3487 | -0.0002 |
| 100000. | 10.00 | 60.0000 | 0.3633 | 0.0290 | 0.3621 | 0.0085 |
| 100000. | 10.00 | 75.0000 | 0.3322 | 0.0182 | 0.3813 | 0.0195 |
| 100000. | 10.00 | 90.0000 | 0.3984 | 0.0050 | 0.3982 | 0.0113 |
| 100000. | 10.00 | 105.0000 | 0.3936 | 0.0123 | 0.3933 | -0.0094 |
| 100000. | 10.00 | 120.0000 | 0.3849 | 0.0314 | 0.3834 | -0.0136 |
| 100000. | 10.00 | 135.0000 | 0.3692 | 0.0413 | 0.3667 | -0.0120 |
| 100000. | 10.00 | 150.0000 | 0.3483 | 0.0456 | 0.3447 | -0.0206 |
| 100000. | 10.00 | 165.0000 | 0.3387 | 0.0631 | 0.3302 | -0.0408 |
| 100000. | 10.00 | 180.0000 | 0.3300 | 0.0875 | 0.3148 | -0.0461 |
| 100000. | 10.00 | 195.0000 | 0.3257 | 0.1100 | 0.3026 | -0.0496 |
| 100000. | 10.00 | 210.0000 | 0.3333 | 0.1260 | 0.3049 | -0.0478 |
| 100000. | 10.00 | 225.0000 | 0.3435 | 0.1386 | 0.3105 | -0.0491 |
| 100000. | 10.00 | 240.0000 | 0.3543 | 0.1589 | 0.3126 | -0.0519 |
| 100000. | 10.00 | 255.0000 | 0.3669 | 0.1839 | 0.3133 | -0.0515 |
| 100000. | 10.00 | 270.0000 | 0.3826 | 0.2195 | 0.3101 | -0.0449 |
| 100000. | 10.00 | 285.0000 | 0.3901 | 0.2541 | 0.2959 | -0.0073 |
| 100000. | 10.00 | 300.0000 | 0.3743 | 0.2433 | 0.2811 | 0.0432 |
| 100000. | 10.00 | 315.0000 | 0.3483 | 0.1983 | 0.2741 | 0.0827 |
| 100000. | 10.00 | 330.0000 | 0.3218 | 0.1211 | 0.2769 | 0.1106 |
| 100000. | 10.00 | 345.0000 | 0.3092 | 0.0268 | 0.2929 | 0.0954 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 100000. | 20.00 | 0. | 0.3474 | 0.1248 | 0.3219 | 0.0391 |
| 100000. | 20.00 | 15.0000 | 0.3542 | 0.1284 | 0.3296 | 0.0178 |
| 100000. | 20.00 | 30.0000 | 0.3672 | 0.1448 | 0.3374 | -0.0045 |
| 100000. | 20.00 | 45.0000 | 0.3828 | 0.1615 | 0.3470 | -0.0083 |
| 100000. | 20.00 | 60.0000 | 0.4024 | 0.1795 | 0.3602 | -0.0010 |
| 100000. | 20.00 | 75.0000 | 0.4199 | 0.1824 | 0.3782 | 0.0059 |
| 100000. | 20.00 | 90.0000 | 0.4295 | 0.1793 | 0.3902 | 0.0068 |
| 100000. | 20.00 | 105.0000 | 0.4273 | 0.1742 | 0.3902 | -0.0024 |
| 100000. | 20.00 | 120.0000 | 0.4161 | 0.1842 | 0.3731 | -0.0007 |
| 100000. | 20.00 | 135.0000 | 0.3867 | 0.1721 | 0.3463 | 0.0049 |
| 100000. | 20.00 | 150.0000 | 0.3595 | 0.1552 | 0.3242 | -0.0063 |
| 100000. | 20.00 | 165.0000 | 0.3384 | 0.1583 | 0.2977 | -0.0291 |
| 100000. | 20.00 | 180.0000 | 0.3387 | 0.1792 | 0.2844 | -0.0412 |
| 100000. | 20.00 | 195.0000 | 0.3508 | 0.2021 | 0.2822 | -0.0508 |
| 100000. | 20.00 | 210.0000 | 0.3625 | 0.2217 | 0.2816 | -0.0537 |
| 100000. | 20.00 | 225.0000 | 0.3844 | 0.2471 | 0.2893 | -0.0551 |
| 100000. | 20.00 | 240.0000 | 0.4099 | 0.2750 | 0.2986 | -0.0569 |
| 100000. | 20.00 | 255.0000 | 0.4322 | 0.3059 | 0.3005 | -0.0541 |
| 100000. | 20.00 | 270.0000 | 0.4512 | 0.3448 | 0.2887 | -0.0366 |
| 100000. | 20.00 | 285.0000 | 0.4532 | 0.3652 | 0.2684 | 0.0058 |
| 100000. | 20.00 | 300.0000 | 0.4303 | 0.3423 | 0.2557 | 0.0515 |
| 100000. | 20.00 | 315.0000 | 0.3943 | 0.2885 | 0.2549 | 0.0851 |
| 100000. | 20.00 | 330.0000 | 0.3636 | 0.2203 | 0.2696 | 0.1048 |
| 100000. | 20.00 | 345.0000 | 0.3461 | 0.1513 | 0.3011 | 0.0791 |
| | | | | | | |
| 100000. | 30.00 | 0. | 0.3924 | 0.2592 | 0.2931 | 0.0304 |
| 100000. | 30.00 | 15.0000 | 0.3978 | 0.2583 | 0.3022 | 0.0158 |
| 100000. | 30.00 | 30.0000 | 0.4109 | 0.2750 | 0.3052 | -0.0093 |
| 100000. | 30.00 | 45.0000 | 0.4311 | 0.2966 | 0.3124 | -0.0168 |
| 100000. | 30.00 | 60.0000 | 0.4540 | 0.3203 | 0.3215 | -0.0115 |
| 100000. | 30.00 | 75.0000 | 0.4670 | 0.3293 | 0.3311 | -0.0039 |
| 100000. | 30.00 | 90.0000 | 0.4778 | 0.3315 | 0.3440 | 0.0013 |
| 100000. | 30.00 | 105.0000 | 0.4788 | 0.3301 | 0.3469 | 0.0027 |
| 100000. | 30.00 | 120.0000 | 0.4642 | 0.3216 | 0.3345 | 0.0142 |
| 100000. | 30.00 | 135.0000 | 0.4385 | 0.2955 | 0.3233 | 0.0207 |
| 100000. | 30.00 | 150.0000 | 0.4028 | 0.2654 | 0.3028 | 0.0105 |
| 100000. | 30.00 | 165.0000 | 0.3769 | 0.2475 | 0.2840 | -0.0130 |
| 100000. | 30.00 | 180.0000 | 0.3672 | 0.2539 | 0.2626 | -0.0373 |
| 100000. | 30.00 | 195.0000 | 0.3819 | 0.2793 | 0.2549 | -0.0534 |
| 100000. | 30.00 | 210.0000 | 0.4043 | 0.3072 | 0.2558 | -0.0607 |
| 100000. | 30.00 | 225.0000 | 0.4361 | 0.3443 | 0.2590 | -0.0675 |
| 100000. | 30.00 | 240.0000 | 0.4677 | 0.3836 | 0.2599 | -0.0634 |
| 100000. | 30.00 | 255.0000 | 0.4993 | 0.4242 | 0.2578 | -0.0539 |
| 100000. | 30.00 | 270.0000 | 0.5147 | 0.4518 | 0.2451 | -0.0257 |
| 100000. | 30.00 | 285.0000 | 0.5108 | 0.4564 | 0.2287 | 0.0171 |
| 100000. | 30.00 | 300.0000 | 0.4857 | 0.4277 | 0.2223 | 0.0597 |
| 100000. | 30.00 | 315.0000 | 0.4484 | 0.3762 | 0.2282 | 0.0860 |
| 100000. | 30.00 | 330.0000 | 0.4053 | 0.3080 | 0.2476 | 0.0897 |
| 100000. | 30.00 | 345.0000 | 0.3955 | 0.2723 | 0.2787 | 0.0680 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bx (oersteds) | By (oersteds) | Bz (oersteds) |
|---|---|---|---|---|---|---|
| 100000. | 40.00 | 0. | 0.4276 | 0.3525 | 0.2404 | 0.0281 |
| 100000. | 40.00 | 15.0000 | 0.4327 | 0.3554 | 0.2466 | 0.0092 |
| 100000. | 40.00 | 30.0000 | 0.4506 | 0.3733 | 0.2520 | -0.0104 |
| 100000. | 40.00 | 45.0000 | 0.4680 | 0.3939 | 0.2515 | -0.0239 |
| 100000. | 40.00 | 60.0000 | 0.4946 | 0.4213 | 0.2581 | -0.0226 |
| 100000. | 40.00 | 75.0000 | 0.5163 | 0.4390 | 0.2714 | -0.0144 |
| 100000. | 40.00 | 90.0000 | 0.5347 | 0.4545 | 0.2814 | -0.0103 |
| 100000. | 40.00 | 105.0000 | 0.5451 | 0.4610 | 0.2909 | 0.0066 |
| 100000. | 40.00 | 120.0000 | 0.5285 | 0.4423 | 0.2883 | 0.0242 |
| 100000. | 40.00 | 135.0000 | 0.4921 | 0.4055 | 0.2765 | 0.0364 |
| 100000. | 40.00 | 150.0000 | 0.4465 | 0.3576 | 0.2660 | 0.0260 |
| 100000. | 40.00 | 165.0000 | 0.4203 | 0.3339 | 0.2554 | -0.0009 |
| 100000. | 40.00 | 180.0000 | 0.4119 | 0.3289 | 0.2457 | -0.0329 |
| 100000. | 40.00 | 195.0000 | 0.4308 | 0.3565 | 0.2359 | -0.0536 |
| 100000. | 40.00 | 210.0000 | 0.4560 | 0.3878 | 0.2298 | -0.0692 |
| 100000. | 40.00 | 225.0000 | 0.4902 | 0.4295 | 0.2243 | -0.0740 |
| 100000. | 40.00 | 240.0000 | 0.5249 | 0.4735 | 0.2161 | -0.0684 |
| 100000. | 40.00 | 255.0000 | 0.5571 | 0.5165 | 0.2026 | -0.0509 |
| 100000. | 40.00 | 270.0000 | 0.5696 | 0.5388 | 0.1844 | -0.0139 |
| 100000. | 40.00 | 285.0000 | 0.5572 | 0.5288 | 0.1735 | 0.0268 |
| 100000. | 40.00 | 300.0000 | 0.5245 | 0.4911 | 0.1715 | 0.0675 |
| 100000. | 40.00 | 315.0000 | 0.4903 | 0.4455 | 0.1881 | 0.0807 |
| 100000. | 40.00 | 330.0000 | 0.4582 | 0.3975 | 0.2157 | 0.0736 |
| 100000. | 40.00 | 345.0000 | 0.4470 | 0.3765 | 0.2316 | 0.0663 |
| 100000. | 50.00 | 0. | 0.4625 | 0.4199 | 0.1921 | 0.0275 |
| 100000. | 50.00 | 15.0000 | 0.4692 | 0.4245 | 0.1996 | 0.0053 |
| 100000. | 50.00 | 30.0000 | 0.4784 | 0.4359 | 0.1967 | -0.0128 |
| 100000. | 50.00 | 45.0000 | 0.5003 | 0.4585 | 0.1982 | -0.0285 |
| 100000. | 50.00 | 60.0000 | 0.5291 | 0.4903 | 0.1956 | -0.0347 |
| 100000. | 50.00 | 75.0000 | 0.5537 | 0.5158 | 0.1997 | -0.0253 |
| 100000. | 50.00 | 90.0000 | 0.5738 | 0.5345 | 0.2077 | -0.0195 |
| 100000. | 50.00 | 105.0000 | 0.5822 | 0.5449 | 0.2049 | 0.0056 |
| 100000. | 50.00 | 120.0000 | 0.5709 | 0.5295 | 0.2119 | 0.0254 |
| 100000. | 50.00 | 135.0000 | 0.5482 | 0.4966 | 0.2283 | 0.0420 |
| 100000. | 50.00 | 150.0000 | 0.5113 | 0.4511 | 0.2385 | 0.0324 |
| 100000. | 50.00 | 165.0000 | 0.4897 | 0.4275 | 0.2388 | 0.0084 |
| 100000. | 50.00 | 180.0000 | 0.4700 | 0.4132 | 0.2228 | -0.0226 |
| 100000. | 50.00 | 195.0000 | 0.4775 | 0.4291 | 0.2034 | -0.0507 |
| 100000. | 50.00 | 210.0000 | 0.4999 | 0.4580 | 0.1868 | -0.0727 |
| 100000. | 50.00 | 225.0000 | 0.5377 | 0.5034 | 0.1730 | -0.0757 |
| 100000. | 50.00 | 240.0000 | 0.5689 | 0.5431 | 0.1557 | -0.0670 |
| 100000. | 50.00 | 255.0000 | 0.5900 | 0.5738 | 0.1325 | -0.0366 |
| 100000. | 50.00 | 270.0000 | 0.5857 | 0.5750 | 0.1116 | -0.0018 |
| 100000. | 50.00 | 285.0000 | 0.5771 | 0.5662 | 0.1069 | 0.0319 |
| 100000. | 50.00 | 300.0000 | 0.5518 | 0.5336 | 0.1244 | 0.0653 |
| 100000. | 50.00 | 315.0000 | 0.5189 | 0.4941 | 0.1391 | 0.0758 |
| 100000. | 50.00 | 330.0000 | 0.4877 | 0.4570 | 0.1542 | 0.0726 |
| 100000. | 50.00 | 345.0000 | 0.4664 | 0.4298 | 0.1725 | 0.0553 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | P[illegible] (oe[illegible]) | By ([illegible]ersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 100000. | 60.00 | 0. | 0.4872 | 0.4647 | 0.1442 | 0.02[illegible] |
| 100000. | 60.00 | 15.0000 | 0.4932 | 0.4707 | 0.1472 | 0.00[illegible] |
| 100000. | 60.00 | 30.0000 | 0.5017 | 0.4795 | 0.1468 | -0.0136 |
| 100000. | 60.00 | 45.0000 | 0.5164 | 0.4972 | 0.1370 | -0.0273 |
| 100000. | 60.00 | 60.0000 | 0.5310 | 0.5137 | 0.1291 | -0.0381 |
| 100000. | 60.00 | 75.0000 | 0.5661 | 0.5491 | 0.1295 | -0.0466 |
| 100000. | 60.00 | 90.0000 | 0.6025 | 0.5869 | 0.1333 | -0.0281 |
| 100000. | 60.00 | 105.0000 | 0.6068 | 0.5895 | 0.1441 | -0.0005 |
| 100000. | 60.00 | 120.0000 | 0.6082 | 0.5874 | 0.1571 | 0.0145 |
| 100000. | 60.00 | 135.0000 | 0.5930 | 0.5686 | 0.1636 | 0.0395 |
| 100000. | 60.00 | 150.0000 | 0.5561 | 0.5285 | 0.1698 | 0.0328 |
| 100000. | 60.00 | 165.0000 | 0.5374 | 0.5084 | 0.1737 | 0.0139 |
| 100000. | 60.00 | 180.0000 | 0.5194 | 0.4881 | 0.1771 | -0.0124 |
| 100000. | 60.00 | 195.0000 | 0.5249 | 0.4955 | 0.1674 | -0.0449 |
| 100000. | 60.00 | 210.0000 | 0.5421 | 0.5176 | 0.1477 | -0.0646 |
| 100000. | 60.00 | 225.0000 | 0.5687 | 0.5518 | 0.1185 | -0.0691 |
| 100000. | 60.00 | 240.0000 | 0.5879 | 0.5782 | 0.0918 | -0.0533 |
| 100000. | 60.00 | 255.0000 | 0.5980 | 0.5930 | 0.0738 | -0.0232 |
| 100000. | 60.00 | 270.0000 | 0.5843 | 0.5803 | 0.0662 | 0.0153 |
| 100000. | 60.00 | 285.0000 | 0.5625 | 0.5579 | 0.0629 | 0.0339 |
| 100000. | 60.00 | 300.0000 | 0.5579 | 0.5506 | 0.0708 | 0.0554 |
| 100000. | 60.00 | 315.0000 | 0.5319 | 0.5183 | 0.0916 | 0.0763 |
| 100000. | 60.00 | 330.0000 | 0.5014 | 0.4836 | 0.1154 | 0.0656 |
| 100000. | 60.00 | 345.0000 | 0.4907 | 0.4695 | 0.1349 | 0.0463 |
| 100000. | 70.00 | 0. | 0.5096 | 0.4982 | 0.1052 | 0.0219 |
| 100000. | 70.00 | 15.0000 | 0.5135 | 0.5017 | 0.1091 | 0.0054 |
| 100000. | 70.00 | 30.0000 | 0.5162 | 0.5050 | 0.1069 | -0.0077 |
| 100000. | 70.00 | 45.0000 | 0.5186 | 0.5080 | 0.1018 | -0.0232 |
| 100000. | 70.00 | 60.0000 | 0.5322 | 0.5222 | 0.0936 | -0.0429 |
| 100000. | 70.00 | 75.0000 | 0.5614 | 0.5531 | 0.0796 | -0.0535 |
| 100000. | 70.00 | 90.0000 | 0.5918 | 0.5862 | 0.0685 | -0.0443 |
| 100000. | 70.00 | 105.0000 | 0.6150 | 0.6107 | 0.0679 | -0.0243 |
| 100000. | 70.00 | 120.0000 | 0.6267 | 0.6223 | 0.0744 | 0.0037 |
| 100000. | 70.00 | 135.0000 | 0.6132 | 0.6056 | 0.0914 | 0.0302 |
| 100000. | 70.00 | 150.0000 | 0.5866 | 0.5752 | 0.1118 | 0.0289 |
| 100000. | 70.00 | 165.0000 | 0.5711 | 0.5581 | 0.1208 | 0.0100 |
| 100000. | 70.00 | 180.0000 | 0.5640 | 0.5513 | 0.1188 | -0.0104 |
| 100000. | 70.00 | 195.0000 | 0.5617 | 0.5509 | 0.1054 | -0.0304 |
| 100000. | 70.00 | 210.0000 | 0.5651 | 0.5570 | 0.0845 | -0.0442 |
| 100000. | 70.00 | 225.0000 | 0.5737 | 0.5684 | 0.0614 | -0.0479 |
| 100000. | 70.00 | 240.0000 | 0.5853 | 0.5826 | 0.0405 | -0.0389 |
| 100000. | 70.00 | 255.0000 | 0.5956 | 0.5949 | 0.0252 | -0.0151 |
| 100000. | 70.00 | 270.0000 | 0.5919 | 0.5912 | 0.0225 | 0.0191 |
| 100000. | 70.00 | 285.0000 | 0.5740 | 0.5716 | 0.0303 | 0.0433 |
| 100000. | 70.00 | 300.0000 | 0.5554 | 0.5508 | 0.0408 | 0.0581 |
| 100000. | 70.00 | 315.0000 | 0.5346 | 0.5272 | 0.0588 | 0.0658 |
| 100000. | 70.00 | 330.0000 | 0.5166 | 0.5074 | 0.0790 | 0.0566 |
| 100000. | 70.00 | 345.0000 | 0.5097 | 0.4993 | 0.0943 | 0.0398 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 100000. | 80.00 | 0. | 0.5307 | 0.5255 | 0.0716 | 0.0190 |
| 100000. | 80.00 | 15.0000 | 0.5332 | 0.5278 | 0.0753 | 0.0051 |
| 100000. | 80.00 | 30.0000 | 0.5365 | 0.5311 | 0.0756 | -0.0088 |
| 100000. | 80.00 | 45.0000 | 0.5414 | 0.5361 | 0.0718 | -0.0232 |
| 100000. | 80.00 | 60.0000 | 0.5495 | 0.5447 | 0.0626 | -0.0362 |
| 100000. | 80.00 | 75.0000 | 0.5610 | 0.5572 | 0.0487 | -0.0437 |
| 100000. | 80.00 | 90.0000 | 0.5741 | 0.5715 | 0.0337 | -0.0425 |
| 100000. | 80.00 | 105.0000 | 0.5859 | 0.5846 | 0.0222 | -0.0327 |
| 100000. | 80.00 | 120.0000 | 0.5933 | 0.5928 | 0.0180 | -0.0176 |
| 100000. | 80.00 | 135.0000 | 0.5947 | 0.5943 | 0.0219 | -0.0035 |
| 100000. | 80.00 | 150.0000 | 0.5908 | 0.5900 | 0.0304 | 0.0037 |
| 100000. | 80.00 | 165.0000 | 0.5841 | 0.5829 | 0.0379 | 0.0027 |
| 100000. | 80.00 | 180.0000 | 0.5772 | 0.5757 | 0.0407 | -0.0040 |
| 100000. | 80.00 | 195.0000 | 0.5720 | 0.5707 | 0.0372 | -0.0129 |
| 100000. | 80.00 | 210.0000 | 0.5699 | 0.5689 | 0.0276 | -0.0196 |
| 100000. | 80.00 | 225.0000 | 0.5704 | 0.5699 | 0.0140 | -0.0199 |
| 100000. | 80.00 | 240.0000 | 0.5712 | 0.5710 | 0.0004 | -0.0115 |
| 100000. | 80.00 | 255.0000 | 0.5697 | 0.5697 | -0.0082 | 0.0043 |
| 100000. | 80.00 | 270.0000 | 0.5650 | 0.5644 | -0.0085 | 0.0230 |
| 100000. | 80.00 | 285.0000 | 0.5574 | 0.5560 | -0.0001 | 0.0392 |
| 100000. | 80.00 | 300.0000 | 0.5485 | 0.5461 | 0.0148 | 0.0493 |
| 100000. | 80.00 | 315.0000 | 0.5399 | 0.5364 | 0.0329 | 0.0514 |
| 100000. | 80.00 | 330.0000 | 0.5333 | 0.5290 | 0.0502 | 0.0452 |
| 100000. | 80.00 | 345.0000 | 0.5303 | 0.5254 | 0.0636 | 0.0332 |
| 100000. | 90.00 | 0. | 0.5610 | 0.5600 | 0 | 0 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 250000. | -90.00 | 0. | 0.5445 | -0.5256 | 0 | 0 |
| 250000. | -80.00 | 0. | 0.5058 | -0.4806 | 0.1384 | 0.0760 |
| 250000. | -80.00 | 15.0000 | 0.5126 | -0.4900 | 0.1160 | 0.0961 |
| 250000. | -80.00 | 30.0000 | 0.5190 | -0.4996 | 0.0896 | 0.1086 |
| 250000. | -80.00 | 45.0000 | 0.5244 | -0.5078 | 0.0627 | 0.1151 |
| 250000. | -80.00 | 60.0000 | 0.5301 | -0.5154 | 0.0357 | 0.1188 |
| 250000. | -80.00 | 75.0000 | 0.5384 | -0.5249 | 0.0068 | 0.1195 |
| 250000. | -80.00 | 90.0000 | 0.5493 | -0.5370 | -0.0231 | 0.1135 |
| 250000. | -80.00 | 105.0000 | 0.5624 | -0.5512 | -0.0496 | 0.1000 |
| 250000. | -80.00 | 120.0000 | 0.5788 | -0.5687 | -0.0702 | 0.0816 |
| 250000. | -80.00 | 135.0000 | 0.6001 | -0.5910 | -0.0872 | 0.0576 |
| 250000. | -80.00 | 150.0000 | 0.6231 | -0.6144 | -0.1014 | 0.0220 |
| 250000. | -80.00 | 165.0000 | 0.6384 | -0.6287 | -0.1076 | -0.0283 |
| 250000. | -80.00 | 180.0000 | 0.6367 | -0.6234 | -0.0977 | -0.0856 |
| 250000. | -80.00 | 195.0000 | 0.6163 | -0.5975 | -0.0696 | -0.1338 |
| 250000. | -80.00 | 210.0000 | 0.5838 | -0.5604 | -0.0292 | -0.1608 |
| 250000. | -80.00 | 225.0000 | 0.5499 | -0.5243 | 0.0148 | -0.1651 |
| 250000. | -80.00 | 240.0000 | 0.5229 | -0.4970 | 0.0560 | -0.1527 |
| 250000. | -80.00 | 255.0000 | 0.5055 | -0.4795 | 0.0919 | -0.1309 |
| 250000. | -80.00 | 270.0000 | 0.4957 | -0.4691 | 0.1217 | -0.1038 |
| 250000. | -80.00 | 285.0000 | 0.4908 | -0.4636 | 0.1440 | -0.0726 |
| 250000. | -80.00 | 300.0000 | 0.4898 | -0.4622 | 0.1573 | -0.0396 |
| 250000. | -80.00 | 315.0000 | 0.4917 | -0.4641 | 0.1624 | -0.0078 |
| 250000. | -80.00 | 330.0000 | 0.4953 | -0.4678 | 0.1612 | 0.0220 |
| 250000. | -80.00 | 345.0000 | 0.4999 | -0.4731 | 0.1536 | 0.0503 |
| 250000. | -70.00 | 0. | 0.4374 | -0.3964 | 0.1699 | 0.0724 |
| 250000. | -70.00 | 15.0000 | 0.4556 | -0.4179 | 0.1537 | 0.0966 |
| 250000. | -70.00 | 30.0000 | 0.4820 | -0.4506 | 0.1312 | 0.1099 |
| 250000. | -70.00 | 45.0000 | 0.4984 | -0.4753 | 0.1050 | 0.1073 |
| 250000. | -70.00 | 60.0000 | 0.5039 | -0.4851 | 0.0819 | 0.1093 |
| 250000. | -70.00 | 75.0000 | 0.5264 | -0.5085 | 0.0558 | 0.1243 |
| 250000. | -70.00 | 90.0000 | 0.5697 | -0.5554 | 0.0226 | 0.1248 |
| 250000. | -70.00 | 105.0000 | 0.6055 | -0.5975 | -0.0088 | 0.0979 |
| 250000. | -70.00 | 120.0000 | 0.6197 | -0.6161 | -0.0268 | 0.0603 |
| 250000. | -70.00 | 135.0000 | 0.6231 | -0.6217 | -0.0269 | 0.0326 |
| 250000. | -70.00 | 150.0000 | 0.6393 | -0.6389 | -0.0184 | 0.0154 |
| 250000. | -70.00 | 165.0000 | 0.6703 | -0.6700 | -0.0115 | -0.0182 |
| 250000. | -70.00 | 180.0000 | 0.6835 | -0.6795 | 0.0034 | -0.0742 |
| 250000. | -70.00 | 195.0000 | 0.6654 | -0.6544 | 0.0263 | -0.1176 |
| 250000. | -70.00 | 210.0000 | 0.6312 | -0.6139 | 0.0448 | -0.1396 |
| 250000. | -70.00 | 225.0000 | 0.5872 | -0.5646 | 0.0620 | -0.1490 |
| 250000. | -70.00 | 240.0000 | 0.5404 | -0.5134 | 0.0945 | -0.1457 |
| 250000. | -70.00 | 255.0000 | 0.5015 | -0.4701 | 0.1133 | -0.1330 |
| 250000. | -70.00 | 270.0000 | 0.4704 | -0.4333 | 0.1453 | -0.1116 |
| 250000. | -70.00 | 285.0000 | 0.4491 | -0.4073 | 0.1732 | -0.0758 |
| 250000. | -70.00 | 300.0000 | 0.4453 | -0.4017 | 0.1887 | -0.0362 |
| 250000. | -70.00 | 315.0000 | 0.4467 | -0.4024 | 0.1937 | -0.0087 |
| 250000. | -70.00 | 330.0000 | 0.4395 | -0.3948 | 0.1925 | 0.0149 |
| 250000. | -70.00 | 345.0000 | 0.4326 | -0.3891 | 0.1839 | 0.0439 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 250000. | -60.00 | 0. | 0.3709 | -0.3286 | 0.1572 | 0.0698 |
| 250000. | -60.00 | 15.0000 | 0.3802 | -0.3426 | 0.1446 | 0.0793 |
| 250000. | -60.00 | 30.0000 | 0.4036 | -0.3667 | 0.1392 | 0.0951 |
| 250000. | -60.00 | 45.0000 | 0.4392 | -0.4061 | 0.1301 | 0.1048 |
| 250000. | -60.00 | 60.0000 | 0.4681 | -0.4425 | 0.1090 | 0.1072 |
| 250000. | -60.00 | 75.0000 | 0.5004 | -0.4792 | 0.0890 | 0.1137 |
| 250000. | -60.00 | 90.0000 | 0.5434 | -0.5262 | 0.0779 | 0.1111 |
| 250000. | -60.00 | 105.0000 | 0.5891 | -0.5776 | 0.0662 | 0.0952 |
| 250000. | -60.00 | 120.0000 | 0.6249 | -0.6199 | 0.0533 | 0.0581 |
| 250000. | -60.00 | 135.0000 | 0.6439 | -0.6418 | 0.0472 | 0.0218 |
| 250000. | -60.00 | 150.0000 | 0.6584 | -0.6558 | 0.0581 | -0.0051 |
| 250000. | -60.00 | 165.0000 | 0.6863 | -0.6805 | 0.0817 | -0.0361 |
| 250000. | -60.00 | 180.0000 | 0.6755 | -0.6596 | 0.1104 | -0.0946 |
| 250000. | -60.00 | 195.0000 | 0.6219 | -0.5955 | 0.1363 | -0.1167 |
| 250000. | -60.00 | 210.0000 | 0.5804 | -0.5472 | 0.1558 | -0.1147 |
| 250000. | -60.00 | 225.0000 | 0.5527 | -0.5175 | 0.1620 | -0.1069 |
| 250000. | -60.00 | 240.0000 | 0.5308 | -0.4941 | 0.1579 | -0.1125 |
| 250000. | -60.00 | 255.0000 | 0.4944 | -0.4498 | 0.1666 | -0.1201 |
| 250000. | -60.00 | 270.0000 | 0.4511 | -0.3970 | 0.1832 | -0.1109 |
| 250000. | -60.00 | 285.0000 | 0.4095 | -0.3459 | 0.2027 | -0.0830 |
| 250000. | -60.00 | 300.0000 | 0.3851 | -0.3146 | 0.2183 | -0.0406 |
| 250000. | -60.00 | 315.0000 | 0.3711 | -0.3005 | 0.2177 | -0.0006 |
| 250000. | -60.00 | 330.0000 | 0.3616 | -0.3010 | 0.1981 | 0.0307 |
| 250000. | -60.00 | 345.0000 | 0.3606 | -0.3096 | 0.1764 | 0.0549 |
| 250000. | -50.00 | 0. | 0.3200 | -0.2783 | 0.1415 | 0.0702 |
| 250000. | -50.00 | 15.0000 | 0.3392 | -0.3044 | 0.1302 | 0.0735 |
| 250000. | -50.00 | 30.0000 | 0.3625 | -0.3309 | 0.1278 | 0.0750 |
| 250000. | -50.00 | 45.0000 | 0.3880 | -0.3554 | 0.1293 | 0.0867 |
| 250000. | -50.00 | 60.0000 | 0.4258 | -0.3945 | 0.1262 | 0.0986 |
| 250000. | -50.00 | 75.0000 | 0.4714 | -0.4456 | 0.1116 | 0.1059 |
| 250000. | -50.00 | 90.0000 | 0.5162 | -0.4976 | 0.0970 | 0.0973 |
| 250000. | -50.00 | 105.0000 | 0.5699 | -0.5561 | 0.0927 | 0.0832 |
| 250000. | -50.00 | 120.0000 | 0.6109 | -0.6011 | 0.1007 | 0.0409 |
| 250000. | -50.00 | 135.0000 | 0.6320 | -0.6211 | 0.1168 | 0.0055 |
| 250000. | -50.00 | 150.0000 | 0.6228 | -0.6045 | 0.1446 | -0.0386 |
| 250000. | -50.00 | 165.0000 | 0.6130 | -0.5864 | 0.1704 | -0.0535 |
| 250000. | -50.00 | 180.0000 | 0.5929 | -0.5579 | 0.1822 | -0.0845 |
| 250000. | -50.00 | 195.0000 | 0.5606 | -0.5211 | 0.1826 | -0.0966 |
| 250000. | -50.00 | 210.0000 | 0.5180 | -0.4746 | 0.1819 | -0.0998 |
| 250000. | -50.00 | 225.0000 | 0.4859 | -0.4390 | 0.1880 | -0.0893 |
| 250000. | -50.00 | 240.0000 | 0.4743 | -0.4200 | 0.2000 | -0.0926 |
| 250000. | -50.00 | 255.0000 | 0.4425 | -0.3776 | 0.2056 | -0.1046 |
| 250000. | -50.00 | 270.0000 | 0.3998 | -0.3225 | 0.2143 | -0.0996 |
| 250000. | -50.00 | 285.0000 | 0.3535 | -0.2629 | 0.2234 | -0.0776 |
| 250000. | -50.00 | 300.0000 | 0.3172 | -0.2247 | 0.2220 | -0.0290 |
| 250000. | -50.00 | 315.0000 | 0.3009 | -0.2200 | 0.2045 | 0.0180 |
| 250000. | -50.00 | 330.0000 | 0.3032 | -0.2372 | 0.1828 | 0.0473 |
| 250000. | -50.00 | 345.0000 | 0.3066 | -0.2547 | 0.1585 | 0.0635 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 250000. | -40.00 | 0. | 0.2919 | -0.2540 | 0.1259 | 0.0698 |
| 250000. | -40.00 | 15.0000 | 0.3149 | -0.2827 | 0.1253 | 0.0598 |
| 250000. | -40.00 | 30.0000 | 0.3269 | -0.2928 | 0.1321 | 0.0606 |
| 250000. | -40.00 | 45.0000 | 0.3545 | -0.3206 | 0.1332 | 0.0717 |
| 250000. | -40.00 | 60.0000 | 0.3951 | -0.3592 | 0.1406 | 0.0856 |
| 250000. | -40.00 | 75.0000 | 0.4561 | -0.4220 | 0.1437 | 0.0964 |
| 250000. | -40.00 | 90.0000 | 0.5146 | -0.4860 | 0.1454 | 0.0860 |
| 250000. | -40.00 | 105.0000 | 0.5608 | -0.5358 | 0.1548 | 0.0589 |
| 250000. | -40.00 | 120.0000 | 0.5918 | -0.5667 | 0.1691 | 0.0227 |
| 250000. | -40.00 | 135.0000 | 0.6033 | -0.5735 | 0.1872 | -0.0111 |
| 250000. | -40.00 | 150.0000 | 0.5849 | -0.5502 | 0.1935 | -0.0444 |
| 250000. | -40.00 | 165.0000 | 0.5705 | -0.5294 | 0.2041 | -0.0596 |
| 250000. | -40.00 | 180.0000 | 0.5437 | -0.4913 | 0.2182 | -0.0811 |
| 250000. | -40.00 | 195.0000 | 0.5022 | -0.4389 | 0.2286 | -0.0855 |
| 250000. | -40.00 | 210.0000 | 0.4778 | -0.4135 | 0.2261 | -0.0792 |
| 250000. | -40.00 | 225.0000 | 0.4535 | -0.3826 | 0.2291 | -0.0826 |
| 250000. | -40.00 | 240.0000 | 0.4266 | -0.3471 | 0.2335 | -0.0838 |
| 250000. | -40.00 | 255.0000 | 0.3949 | -0.3059 | 0.2333 | -0.0892 |
| 250000. | -40.00 | 270.0000 | 0.3508 | -0.2503 | 0.2300 | -0.0866 |
| 250000. | -40.00 | 285.0000 | 0.3014 | -0.1927 | 0.2229 | -0.0638 |
| 250000. | -40.00 | 300.0000 | 0.2645 | -0.1557 | 0.2133 | -0.0152 |
| 250000. | -40.00 | 315.0000 | 0.2566 | -0.1596 | 0.1984 | 0.0321 |
| 250000. | -40.00 | 330.0000 | 0.2621 | -0.1858 | 0.1734 | 0.0639 |
| 250000. | -40.00 | 345.0000 | 0.2762 | -0.2241 | 0.1434 | 0.0744 |
| | | | | | | |
| 250000. | -30.00 | 0. | 0.2926 | -0.2556 | 0.1251 | 0.0685 |
| 250000. | -30.00 | 15.0000 | 0.2976 | -0.2652 | 0.1273 | 0.0452 |
| 250000. | -30.00 | 30.0000 | 0.3133 | -0.2785 | 0.1328 | 0.0545 |
| 250000. | -30.00 | 45.0000 | 0.3443 | -0.3066 | 0.1484 | 0.0499 |
| 250000. | -30.00 | 60.0000 | 0.3751 | -0.3297 | 0.1656 | 0.0681 |
| 250000. | -30.00 | 75.0000 | 0.4297 | -0.3808 | 0.1829 | 0.0785 |
| 250000. | -30.00 | 90.0000 | 0.4854 | -0.4390 | 0.1963 | 0.0661 |
| 250000. | -30.00 | 105.0000 | 0.5296 | -0.4823 | 0.2146 | 0.0418 |
| 250000. | -30.00 | 120.0000 | 0.5539 | -0.4982 | 0.2422 | 0.0012 |
| 250000. | -30.00 | 135.0000 | 0.5498 | -0.4830 | 0.2[illegible]19 | -0.0206 |
| 250000. | -30.00 | 150.0000 | 0.5429 | -0.4696 | 0.2691 | -0.0425 |
| 250000. | -30.00 | 165.0000 | 0.5209 | -0.4367 | 0.2771 | -0.0622 |
| 250000. | -30.00 | 180.0000 | 0.4898 | -0.3956 | 0.2777 | -0.0726 |
| 250000. | -30.00 | 195.0000 | 0.4543 | -0.3600 | 0.2671 | -0.0738 |
| 250000. | -30.00 | 210.0000 | 0.4312 | -0.3258 | 0.2726 | -0.0740 |
| 250000. | -30.00 | 225.0000 | 0.4014 | -0.2886 | 0.2694 | -0.0722 |
| 250000. | -30.00 | 240.0000 | 0.3740 | -0.2589 | 0.2605 | -0.0707 |
| 250000. | -30.00 | 255.0000 | 0.3473 | -0.2264 | 0.2526 | -0.0746 |
| 250000. | -30.00 | 270.0000 | 0.3[illegible]20 | -0.1783 | 0.2459 | -0.0715 |
| 250000. | -30.00 | 285.0000 | 0.2742 | -0.1303 | 0.2364 | -0.0463 |
| 250000. | -30.00 | 300.0000 | 0.2440 | -0.1034 | 0.2211 | -0.0011 |
| 250000. | -30.00 | 315.0000 | 0.2346 | -0.1173 | 0.1979 | 0.0458 |
| 250000. | -30.00 | 330.0000 | 0.2454 | -0.1566 | 0.1715 | 0.0794 |
| 250000. | -30.00 | 345.0000 | 0.2727 | -0.2140 | 0.1460 | 0.0852 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 250000. | -20.00 | 0. | 0.3080 | -0.2509 | 0.1636 | 0.0716 |
| 250000. | -20.00 | 15.0000 | 0.3136 | -0.2686 | 0.1569 | 0.0396 |
| 250000. | -20.00 | 30.0000 | 0.3230 | -0.2723 | 0.1698 | 0.0363 |
| 250000. | -20.00 | 45.0000 | 0.3415 | -0.2800 | 0.1925 | 0.0341 |
| 250000. | -20.00 | 60.0000 | 0.3672 | -0.2975 | 0.2098 | 0.0482 |
| 250000. | -20.00 | 75.0000 | 0.4041 | -0.3257 | 0.2319 | 0.0587 |
| 250000. | -20.00 | 90.0000 | 0.4549 | -0.3753 | 0.2527 | 0.0473 |
| 250000. | -20.00 | 105.0000 | 0.4880 | -0.3968 | 0.2835 | 0.0171 |
| 250000. | -20.00 | 120.0000 | 0.4940 | -0.3878 | 0.3058 | -0.0111 |
| 250000. | -20.00 | 135.0000 | 0.4857 | -0.3713 | 0.3121 | -0.0259 |
| 250000. | -20.00 | 150.0000 | 0.4738 | -0.3513 | 0.3151 | -0.0424 |
| 250000. | -20.00 | 165.0000 | 0.4490 | -0.3187 | 0.3114 | -0.0555 |
| 250000. | -20.00 | 180.0000 | 0.4236 | -0.2822 | 0.3088 | -0.0667 |
| 250000. | -20.00 | 195.0000 | 0.4054 | -0.2510 | 0.3115 | -0.0656 |
| 250000. | -20.00 | 210.0000 | 0.3762 | -0.2155 | 0.3018 | -0.0637 |
| 250000. | -20.00 | 225.0000 | 0.3530 | -0.1884 | 0.2920 | -0.0622 |
| 250000. | -20.00 | 240.0000 | 0.3356 | -0.1661 | 0.2856 | -0.0588 |
| 250000. | -20.00 | 255.0000 | 0.3154 | -0.1380 | 0.2765 | -0.0631 |
| 250000. | -20.00 | 270.0000 | 0.2894 | -0.0997 | 0.2654 | -0.0580 |
| 250000. | -20.00 | 285.0000 | 0.2644 | -0.0606 | 0.2548 | -0.0360 |
| 250000. | -20.00 | 300.0000 | 0.2435 | -0.0458 | 0.2388 | 0.0122 |
| 250000. | -20.00 | 315.0000 | 0.2388 | -0.0682 | 0.2210 | 0.0592 |
| 250000. | -20.00 | 330.0000 | 0.2506 | -0.1205 | 0.2011 | 0.0885 |
| 250000. | -20.00 | 345.0000 | 0.2775 | -0.1903 | 0.1775 | 0.0963 |
| 250000. | -10.00 | 0. | 0.3073 | -0.2025 | 0.2209 | 0.0678 |
| 2500C | -10.00 | 15.0000 | 0.3249 | -0.2307 | 0.2256 | 0.0381 |
| 250000. | -10.00 | 30.0000 | 0.3298 | -0.2301 | 0.2352 | 0.0215 |
| 250000. | -10.00 | 45.0000 | 0.3369 | -0.2197 | 0.2548 | 0.0178 |
| 250000. | -10.00 | 60.0000 | 0.3583 | -0.2276 | 0.2746 | 0.0344 |
| 250000. | -10.00 | 75.0000 | 0.3859 | -0.2494 | 0.2914 | 0.0421 |
| 250000. | -10.00 | 90.0000 | 0.4227 | -0.2840 | 0.3116 | 0.0305 |
| 250000. | -10.00 | 105.0000 | 0.4336 | -0.2836 | 0.3280 | -0.0016 |
| 250000. | -10.00 | 120.0000 | 0.4312 | -0.2564 | 0.3460 | -0.0209 |
| 250000. | -10.00 | 135.0000 | 0.4244 | -0.2343 | 0.3530 | -0.0251 |
| 250000. | -10.00 | 150.0000 | 0.4123 | -0.2179 | 0.3480 | -0.0370 |
| 250000. | -10.00 | 165.0000 | 0.3968 | -0.1919 | 0.3434 | -0.0519 |
| 250000. | -10.00 | 180.0000 | 0.3771 | -0.1566 | 0.3378 | -0.0598 |
| 250000. | -10.00 | 195.0000 | 0.3520 | -0.1259 | 0.3237 | -0.0570 |
| 250000. | -10.00 | 210.0000 | 0.3349 | -0.1018 | 0.3143 | -0.0569 |
| 250000. | -10.00 | 225.0000 | 0.3207 | -0.0835 | 0.3052 | -0.0522 |
| 250000. | -10.00 | 240.0000 | 0.3078 | -0.0655 | 0.2962 | -0.0516 |
| 250000. | -10.00 | 255.0000 | 0.3006 | -0.0448 | 0.2922 | -0.0546 |
| 250000. | -10.00 | 270.0000 | 0.2928 | -0.0099 | 0.2881 | -0.0511 |
| 250000. | -10.00 | 285.0000 | 0.2815 | 0.0252 | 0.2791 | -0.0262 |
| 250000. | -10.00 | 300.0000 | 0.2702 | 0.0360 | 0.2667 | 0.0238 |
| 250000. | -10.00 | 315.0000 | 0.2566 | 0.0002 | 0.2472 | 0.0689 |
| 250000. | -10.00 | 330.0000 | 0.2552 | -0.0618 | 0.2274 | 0.0978 |
| 250000. | -10.00 | 345.0000 | 0.2808 | -0.1438 | 0.2190 | 0.1011 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 250000. | 0.00 | 0. | 0.3014 | -0.1230 | 0.2685 | 0.0601 |
| 250000. | 0.00 | 15.0000 | 0.3188 | -0.1363 | 0.2866 | 0.0297 |
| 250000. | 0.00 | 30.0000 | 0.3278 | -0.1335 | 0.2992 | 0.0114 |
| 250000. | 0.00 | 45.0000 | 0.3322 | -0.1159 | 0.3113 | 0.0071 |
| 250000. | 0.00 | 60.0000 | 0.3484 | -0.1122 | 0.3292 | 0.0208 |
| 250000. | 0.00 | 75.0000 | 0.3694 | -0.1292 | 0.3448 | 0.0300 |
| 250000. | 0.00 | 90.0000 | 0.3936 | -0.1534 | 0.3620 | 0.0187 |
| 250000. | 0.00 | 105.0000 | 0.4027 | -0.1449 | 0.3756 | -0.0096 |
| 250000. | 0.00 | 120.0000 | 0.3889 | -0.1139 | 0.3712 | -0.0221 |
| 250000. | 0.00 | 135.0000 | 0.3725 | -0.0932 | 0.3601 | -0.0210 |
| 250000. | 0.00 | 150.0000 | 0.3599 | -0.0806 | 0.3495 | -0.0298 |
| 250000. | 0.00 | 165.0000 | 0.3451 | -0.0584 | 0.3367 | -0.0479 |
| 250000. | 0.00 | 180.0000 | 0.3322 | -0.0255 | 0.3272 | -0.0516 |
| 250000. | 0.00 | 195.0000 | 0.3291 | -0.0001 | 0.3251 | -0.0511 |
| 250000. | 0.00 | 210.0000 | 0.3204 | 0.0146 | 0.3164 | -0.0482 |
| 250000. | 0.00 | 225.0000 | 0.3144 | 0.0263 | 0.3100 | -0.0455 |
| 250000. | 0.00 | 240.0000 | 0.3164 | 0.0386 | 0.3101 | -0.0496 |
| 250000. | 0.00 | 255.0000 | 0.3180 | 0.0620 | 0.3077 | -0.0509 |
| 250000. | 0.00 | 270.0000 | 0.3205 | 0.0965 | 0.3029 | -0.0470 |
| 250000. | 0.00 | 285.0000 | 0.3233 | 0.1324 | 0.2945 | -0.0173 |
| 250000. | 0.00 | 300.0000 | 0.3097 | 0.1335 | 0.2775 | 0.0330 |
| 250000. | 0.00 | 315.0000 | 0.2936 | 0.0907 | 0.2683 | 0.0774 |
| 250000. | 0.00 | 330.0000 | 0.2830 | 0.0176 | 0.2621 | 0.1051 |
| 250000. | 0.00 | 345.0000 | 0.2834 | -0.0685 | 0.2569 | 0.0982 |
| 250000. | 10.00 | 0. | 0.3101 | -0.0080 | 0.3064 | 0.0472 |
| 250000. | 10.00 | 15.0000 | 0.3213 | -0.0099 | 0.3205 | 0.0211 |
| 250000. | 10.00 | 30.0000 | 0.3328 | 0.0018 | 0.3327 | 0.0040 |
| 250000. | 10.00 | 45.0000 | 0.3409 | 0.0167 | 0.3405 | 0.0002 |
| 250000. | 10.00 | 60.0000 | 0.3549 | 0.0282 | 0.3536 | 0.0085 |
| 250000. | 10.00 | 75.0000 | 0.3731 | 0.0180 | 0.3722 | 0.0189 |
| 250000. | 10.00 | 90.0000 | 0.3886 | 0.0053 | 0.3884 | 0.0110 |
| 250000. | 10.00 | 105.0000 | 0.3847 | 0.0121 | 0.3845 | -0.0087 |
| 250000. | 10.00 | 120.0000 | 0.3762 | 0.0305 | 0.3747 | -0.0131 |
| 250000. | 10.00 | 135.0000 | 0.3609 | 0.0400 | 0.3584 | -0.0118 |
| 250000. | 10.00 | 150.0000 | 0.3409 | 0.0441 | 0.3374 | -0.0203 |
| 250000. | 10.00 | 165.0000 | 0.3311 | 0.0610 | 0.3231 | -0.0397 |
| 250000. | 10.00 | 180.0000 | 0.3229 | 0.0849 | 0.3083 | -0.0453 |
| 250000. | 10.00 | 195.0000 | 0.3193 | 0.1070 | 0.2969 | -0.0487 |
| 250000. | 10.00 | 210.0000 | 0.3264 | 0.1230 | 0.2986 | -0.0471 |
| 250000. | 10.00 | 225.0000 | 0.3362 | 0.1359 | 0.3037 | -0.0483 |
| 250000. | 10.00 | 240.0000 | 0.3468 | 0.1558 | 0.3058 | -0.0500 |
| 250000. | 10.00 | 255.0000 | 0.3591 | 0.1804 | 0.3063 | -0.0503 |
| 250000. | 10.00 | 270.0000 | 0.3741 | 0.2152 | 0.3029 | -0.0434 |
| 250000. | 10.00 | 285.0000 | 0.3811 | 0.2481 | 0.2891 | -0.0069 |
| 250000. | 10.00 | 300.0000 | 0.3657 | 0.2376 | 0.2748 | 0.0420 |
| 250000. | 10.00 | 315.0000 | 0.3404 | 0.1936 | 0.2681 | 0.0806 |
| 250000. | 10.00 | 330.0000 | 0.3147 | 0.1188 | 0.2709 | 0.1072 |
| 250000. | 10.00 | 345.0000 | 0.3022 | 0.0282 | 0.2863 | 0.0927 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 250000. | 20.00 | 0. | 0.3394 | 0.1230 | 0.3140 | 0.0388 |
| 250000. | 20.00 | 15.0000 | 0.3460 | 0.1259 | 0.3219 | 0.0176 |
| 250000. | 20.00 | 30.0000 | 0.3586 | 0.1414 | 0.3295 | -0.0038 |
| 250000. | 20.00 | 45.0000 | 0.3738 | 0.1578 | 0.3388 | -0.0077 |
| 250000. | 20.00 | 60.0000 | 0.3927 | 0.1749 | 0.3516 | -0.0008 |
| 250000. | 20.00 | 75.0000 | 0.4094 | 0.1777 | 0.3688 | 0.0059 |
| 250000. | 20.00 | 90.0000 | 0.4188 | 0.1747 | 0.3806 | 0.0066 |
| 250000. | 20.00 | 105.0000 | 0.4169 | 0.1702 | 0.3806 | -0.0022 |
| 250000. | 20.00 | 120.0000 | 0.4061 | 0.1793 | 0.3644 | -0.0007 |
| 250000. | 20.00 | 135.0000 | 0.3784 | 0.1680 | 0.3390 | 0.0044 |
| 250000. | 20.00 | 150.0000 | 0.3522 | 0.1521 | 0.3176 | -0.0065 |
| 250000. | 20.00 | 165.0000 | 0.3322 | 0.1552 | 0.2924 | -0.0284 |
| 250000. | 20.00 | 180.0000 | 0.3321 | 0.1751 | 0.2792 | -0.0405 |
| 250000. | 20.00 | 195.0000 | 0.3434 | 0.1974 | 0.2765 | -0.0497 |
| 250000. | 20.00 | 210.0000 | 0.3551 | 0.2171 | 0.2760 | -0.0527 |
| 250000. | 20.00 | 225.0000 | 0.3763 | 0.2419 | 0.2831 | -0.0542 |
| 250000. | 20.00 | 240.0000 | 0.4008 | 0.2692 | 0.2917 | -0.0556 |
| 250000. | 20.00 | 255.0000 | 0.4225 | 0.2996 | 0.2932 | -0.0525 |
| 250000. | 20.00 | 270.0000 | 0.4408 | 0.3370 | 0.2819 | -0.0354 |
| 250000. | 20.00 | 285.0000 | 0.4427 | 0.3564 | 0.2625 | 0.0055 |
| 250000. | 20.00 | 300.0000 | 0.4207 | 0.3343 | 0.2503 | 0.0501 |
| 250000. | 20.00 | 315.0000 | 0.3860 | 0.2824 | 0.2497 | 0.0829 |
| 250000. | 20.00 | 330.0000 | 0.3556 | 0.2158 | 0.2638 | 0.1015 |
| 250000. | 20.00 | 345.0000 | 0.3384 | 0.1490 | 0.2939 | 0.0773 |
| 250000. | 30.00 | 0. | 0.3835 | 0.2533 | 0.2863 | 0.0306 |
| 250000. | 30.00 | 15.0000 | 0.3887 | 0.2525 | 0.2952 | 0.0154 |
| 250000. | 30.00 | 30.0000 | 0.4013 | 0.2682 | 0.2984 | -0.0084 |
| 250000. | 30.00 | 45.0000 | 0.4208 | 0.2893 | 0.3052 | -0.0158 |
| 250000. | 30.00 | 60.0000 | 0.4429 | 0.3120 | 0.3142 | -0.0110 |
| 250000. | 30.00 | 75.0000 | 0.4559 | 0.3209 | 0.3238 | -0.0037 |
| 250000. | 30.00 | 90.0000 | 0.4664 | 0.3232 | 0.3362 | 0.0011 |
| 250000. | 30.00 | 105.0000 | 0.4674 | 0.3218 | 0.3390 | 0.0028 |
| 250000. | 30.00 | 120.0000 | 0.4534 | 0.3136 | 0.3272 | 0.0135 |
| 250000. | 30.00 | 135.0000 | 0.4283 | 0.2886 | 0.3159 | 0.0196 |
| 250000. | 30.00 | 150.0000 | 0.3942 | 0.2597 | 0.2964 | 0.0097 |
| 250000. | 30.00 | 165.0000 | 0.3694 | 0.2429 | 0.2780 | -0.0130 |
| 250000. | 30.00 | 180.0000 | 0.3604 | 0.2492 | 0.2578 | -0.0365 |
| 250000. | 30.00 | 195.0000 | 0.3745 | 0.2738 | 0.2502 | -0.0521 |
| 250000. | 30.00 | 210.0000 | 0.3962 | 0.3010 | 0.2507 | -0.0594 |
| 250000. | 30.00 | 225.0000 | 0.4269 | 0.3370 | 0.2536 | -0.0657 |
| 250000. | 30.00 | 240.0000 | 0.4576 | 0.3753 | 0.2543 | -0.0618 |
| 250000. | 30.00 | 255.0000 | 0.4879 | 0.4145 | 0.2519 | -0.0523 |
| 250000. | 30.00 | 270.0000 | 0.5029 | 0.4415 | 0.2395 | -0.0249 |
| 250000. | 30.00 | 285.0000 | 0.4991 | 0.4458 | 0.2237 | 0.0166 |
| 250000. | 30.00 | 300.0000 | 0.4747 | 0.4179 | 0.2175 | 0.0579 |
| 250000. | 30.00 | 315.0000 | 0.4384 | 0.3678 | 0.2234 | 0.0836 |
| 250000. | 30.00 | 330.0000 | 0.3974 | 0.3024 | 0.2425 | 0.0873 |
| 250000. | 30.00 | 345.0000 | 0.3868 | 0.2667 | 0.2721 | 0.0664 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 250000. | 40.00 | 0. | 0.4189 | 0.3451 | 0.2357 | 0.0283 |
| 250000. | 40.00 | 15.0000 | 0.4238 | 0.3478 | 0.2419 | 0.0093 |
| 250000. | 40.00 | 30.0000 | 0.4405 | 0.3646 | 0.2470 | -0.0098 |
| 250000. | 40.00 | 45.0000 | 0.4577 | 0.3847 | 0.2468 | -0.0226 |
| 250000. | 40.00 | 60.0000 | 0.4834 | 0.4112 | 0.2531 | -0.0216 |
| 250000. | 40.00 | 75.0000 | 0.5042 | 0.4284 | 0.2656 | -0.0139 |
| 250000. | 40.00 | 90.0000 | 0.5217 | 0.4431 | 0.2753 | -0.0097 |
| 250000. | 40.00 | 105.0000 | 0.5314 | 0.4491 | 0.2839 | 0.0063 |
| 250000. | 40.00 | 120.0000 | 0.5156 | 0.4314 | 0.2814 | 0.0231 |
| 250000. | 40.00 | 135.0000 | 0.4810 | 0.3961 | 0.2708 | 0.0345 |
| 250000. | 40.00 | 150.0000 | 0.4377 | 0.3506 | 0.2609 | 0.0245 |
| 250000. | 40.00 | 165.0000 | 0.4125 | 0.3276 | 0.2506 | -0.0014 |
| 250000. | 40.00 | 180.0000 | 0.4045 | 0.3234 | 0.2408 | -0.0321 |
| 250000. | 40.00 | 195.0000 | 0.4222 | 0.3494 | 0.2310 | -0.0523 |
| 250000. | 40.00 | 210.0000 | 0.4467 | 0.3301 | 0.2248 | -0.0672 |
| 250000. | 40.00 | 225.0000 | 0.4797 | 0.4206 | 0.2192 | -0.0720 |
| 250000. | 40.00 | 240.0000 | 0.5133 | 0.4631 | 0.2111 | -0.0665 |
| 250000. | 40.00 | 255.0000 | 0.5440 | 0.5043 | 0.1979 | -0.0492 |
| 250000. | 40.00 | 270.0000 | 0.5560 | 0.5257 | 0.1805 | -0.0136 |
| 250000. | 40.00 | 285.0000 | 0.5443 | 0.5165 | 0.1699 | 0.0259 |
| 250000. | 40.00 | 300.0000 | 0.5131 | 0.4803 | 0.1685 | 0.0650 |
| 250000. | 40.00 | 315.0000 | 0.4797 | 0.4358 | 0.1843 | 0.0786 |
| 250000. | 40.00 | 330.0000 | 0.4487 | 0.3895 | 0.2106 | 0.0723 |
| 250000. | 40.00 | 345.0000 | 0.4367 | 0.3678 | 0.2266 | 0.0641 |
| 250000. | 50.00 | 0. | 0.4533 | 0.4114 | 0.1884 | 0.0274 |
| 250000. | 50.00 | 15.0000 | 0.4594 | 0.4157 | 0.1956 | 0.0056 |
| 250000. | 50.00 | 30.0000 | 0.4688 | 0.4269 | 0.1933 | -0.0121 |
| 250000. | 50.00 | 45.0000 | 0.4896 | 0.4485 | 0.1943 | -0.0271 |
| 250000. | 50.00 | 60.0000 | 0.5171 | 0.4789 | 0.1922 | -0.0329 |
| 250000. | 50.00 | 75.0000 | 0.5409 | 0.5035 | 0.196. | -0.0246 |
| 250000. | 50.00 | 90.0000 | 0.5604 | 0.5219 | 0.2035 | -0.0184 |
| 250000. | 50.00 | 105.0000 | 0.5684 | 0.5314 | 0.2016 | 0.0053 |
| 250000. | 50.00 | 120.0000 | 0.5577 | 0.5168 | 0.2083 | 0.0244 |
| 250000. | 50.00 | 135.0000 | 0.5354 | 0.4851 | 0.2231 | 0.0398 |
| 250000. | 50.00 | 150.0000 | 0.5003 | 0.4419 | 0.2326 | 0.0307 |
| 250000. | 50.00 | 165.0000 | 0.4791 | 0.4188 | 0.2325 | 0.0075 |
| 250000. | 50.00 | 180.0000 | 0.4609 | 0.4056 | 0.2178 | -0.0223 |
| 250000. | 50.00 | 195.0000 | 0.4682 | 0.4207 | 0.1993 | -0.0495 |
| 250000. | 50.00 | 210.0000 | 0.4900 | 0.4490 | 0.1833 | -0.0703 |
| 250000. | 50.00 | 225.0000 | 0.5260 | 0.4924 | 0.1695 | -0.0735 |
| 250000. | 50.00 | 240.0000 | 0.5561 | 0.5309 | 0.1524 | -0.0648 |
| 250000. | 50.00 | 255.0000 | 0.5763 | 0.5603 | 0.1302 | -0.0358 |
| 250000. | 50.00 | 270.0000 | 0.5728 | 0.5620 | 0.1104 | -0.0020 |
| 250000. | 50.00 | 285.0000 | 0.5640 | 0.5531 | 0.1058 | 0.0310 |
| 250000. | 50.00 | 300.0000 | 0.5397 | 0.5220 | 0.1219 | 0.0633 |
| 250000. | 50.00 | 315.0000 | 0.5080 | 0.4837 | 0.1367 | 0.0738 |
| 250000. | 50.00 | 330.0000 | 0.4780 | 0.4477 | 0.1519 | 0.0706 |
| 250000. | 50.00 | 345.0000 | 0.4575 | 0.4214 | 0.1698 | 0.0540 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 250000. | 60.00 | 0. | 0.4781 | 0.4560 | 0.1417 | 0.0236 |
| 250000. | 60.00 | 15.0000 | 0.4836 | 0.4614 | 0.1449 | 0.0048 |
| 250000. | 60.00 | 30.0000 | 0.4918 | 0.4700 | 0.1444 | -0.0127 |
| 250000. | 60.00 | 45.0000 | 0.5060 | 0.4868 | 0.1355 | -0.0262 |
| 250000. | 60.00 | 60.0000 | 0.5209 | 0.5036 | 0.1280 | -0.0366 |
| 250000. | 60.00 | 75.0000 | 0.5539 | 0.5371 | 0.1280 | -0.0440 |
| 250000. | 60.00 | 90.0000 | 0.5878 | 0.5723 | 0.1313 | -0.0268 |
| 250000. | 60.00 | 105.0000 | 0.5929 | 0.5758 | 0.1411 | -0.0008 |
| 250000. | 60.00 | 120.0000 | 0.5938 | 0.5735 | 0.1533 | 0.0143 |
| 250000. | 60.00 | 135.0000 | 0.5789 | 0.5550 | 0.1602 | 0.0371 |
| 250000. | 60.00 | 150.0000 | 0.5446 | 0.5175 | 0.1668 | 0.0311 |
| 250000. | 60.00 | 165.0000 | 0.5262 | 0.4975 | 0.1707 | 0.0127 |
| 250000. | 60.00 | 180.0000 | 0.5096 | 0.4791 | 0.1732 | -0.0128 |
| 250000. | 60.00 | 195.0000 | 0.5144 | 0.4859 | 0.1634 | -0.0436 |
| 250000. | 60.00 | 210.0000 | 0.5310 | 0.5072 | 0.1441 | -0.0626 |
| 250000. | 60.00 | 225.0000 | 0.5562 | 0.5398 | 0.1163 | -0.0669 |
| 250000. | 60.00 | 240.0000 | 0.5749 | 0.5654 | 0.0905 | -0.0518 |
| 250000. | 60.00 | 255.0000 | 0.5847 | 0.5796 | 0.0729 | -0.0228 |
| 250000. | 60.00 | 270.0000 | 0.5722 | 0.5683 | 0.0652 | 0.0138 |
| 250000. | 60.00 | 285.0000 | 0.5522 | 0.5476 | 0.0624 | 0.0330 |
| 250000. | 60.00 | 300.0000 | 0.5462 | 0.5389 | 0.0704 | 0.0542 |
| 250000. | 60.00 | 315.0000 | 0.5212 | 0.5080 | 0.0904 | 0.0735 |
| 250000. | 60.00 | 330.0000 | 0.4924 | 0.4749 | 0.1134 | 0.0640 |
| 250000. | 60.00 | 345.0000 | 0.4814 | 0.4607 | 0.1322 | 0.0454 |
| 250000. | 70.00 | 0. | 0.5003 | 0.4890 | 0.1033 | 0.0218 |
| 250000. | 70.00 | 15.0000 | 0.5037 | 0.4922 | 0.1071 | 0.0057 |
| 250000. | 70.00 | 30.0000 | 0.5066 | 0.4955 | 0.1051 | -0.0075 |
| 250000. | 70.00 | 45.0000 | 0.5097 | 0.4993 | 0.1002 | -0.0225 |
| 250000. | 70.00 | 60.0000 | 0.5230 | 0.5132 | 0.0922 | -0.0408 |
| 250000. | 70.00 | 75.0000 | 0.5503 | 0.5423 | 0.0791 | -0.0504 |
| 250000. | 70.00 | 90.0000 | 0.5789 | 0.5734 | 0.0686 | -0.0415 |
| 250000. | 70.00 | 105.0000 | 0.6006 | 0.5963 | 0.0679 | -0.0226 |
| 250000. | 70.00 | 120.0000 | 0.6110 | 0.6065 | 0.0742 | 0.0036 |
| 250000. | 70.00 | 135.0000 | 0.5986 | 0.5911 | 0.0900 | 0.0277 |
| 250000. | 70.00 | 150.0000 | 0.5742 | 0.5631 | 0.1090 | 0.0267 |
| 250000. | 70.00 | 165.0000 | 0.5593 | 0.5467 | 0.1177 | 0.0091 |
| 250000. | 70.00 | 180.0000 | 0.5523 | 0.5399 | 0.1159 | -0.0106 |
| 250000. | 70.00 | 195.0000 | 0.5503 | 0.5397 | 0.1033 | -0.0299 |
| 250000. | 70.00 | 210.0000 | 0.5538 | 0.5458 | 0.0832 | -0.0432 |
| 250000. | 70.00 | 225.0000 | 0.5622 | 0.5570 | 0.0607 | -0.0465 |
| 250000. | 70.00 | 240.0000 | 0.5732 | 0.5705 | 0.0403 | -0.0375 |
| 250000. | 70.00 | 255.0000 | 0.5823 | 0.5816 | 0.0256 | -0.0144 |
| 250000. | 70.00 | 270.0000 | 0.5786 | 0.5779 | 0.0227 | 0.0178 |
| 250000. | 70.00 | 285.0000 | 0.5620 | 0.5597 | 0.0299 | 0.0413 |
| 250000. | 70.00 | 300.0000 | 0.5443 | 0.5399 | 0.0404 | 0.0561 |
| 250000. | 70.00 | 315.0000 | 0.5246 | 0.5175 | 0.0579 | 0.0635 |
| 250000. | 70.00 | 330.0000 | 0.5076 | 0.4986 | 0.0777 | 0.0551 |
| 250000. | 70.00 | 345.0000 | 0.5006 | 0.4904 | 0.0928 | 0.0392 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 250000. | 80.00 | 0. | 0.5212 | 0.5162 | 0.0699 | 0.0191 |
| 250000. | 80.00 | 15.0000 | 0.5234 | 0.5182 | 0.0736 | 0.0055 |
| 250000. | 80.00 | 30.0000 | 0.5266 | 0.5214 | 0.0739 | -0.0081 |
| 250000. | 80.00 | 45.0000 | 0.5315 | 0.5264 | 0.0701 | -0.0220 |
| 250000. | 80.00 | 60.0000 | 0.5393 | 0.5347 | 0.0612 | -0.0344 |
| 250000. | 80.00 | 75.0000 | 0.5503 | 0.5466 | 0.0480 | -0.0413 |
| 250000. | 80.00 | 90.0000 | 0.5626 | 0.5601 | 0.0339 | -0.0401 |
| 250000. | 80.00 | 105.0000 | 0.5736 | 0.5723 | 0.0232 | -0.0308 |
| 250000. | 80.00 | 120.0000 | 0.5805 | 0.5799 | 0.0193 | -0.0168 |
| 250000. | 80.00 | 135.0000 | 0.5817 | 0.5812 | 0.0231 | -0.0037 |
| 250000. | 80.00 | 150.0000 | 0.5781 | 0.5772 | 0.0310 | 0.0028 |
| 250000. | 80.00 | 165.0000 | 0.5720 | 0.5707 | 0.0379 | 0.0016 |
| 250000. | 80.00 | 180.0000 | 0.5656 | 0.5642 | 0.0402 | -0.0049 |
| 250000. | 80.00 | 195.0000 | 0.5609 | 0.5596 | 0.0366 | -0.0133 |
| 250000. | 80.00 | 210.0000 | 0.5590 | 0.5580 | 0.0272 | -0.0195 |
| 250000. | 80.00 | 225.0000 | 0.5593 | 0.5588 | 0.0141 | -0.0195 |
| 250000. | 80.00 | 240.0000 | 0.5600 | 0.5598 | 0.0011 | -0.0114 |
| 250000. | 80.00 | 255.0000 | 0.5586 | 0.5585 | -0.0072 | 0.0038 |
| 250000. | 80.00 | 270.0000 | 0.5541 | 0.5537 | -0.0075 | 0.0217 |
| 250000. | 80.00 | 285.0000 | 0.5470 | 0.5457 | 0.0006 | 0.0375 |
| 250000. | 80.00 | 300.0000 | 0.5386 | 0.5363 | 0.0148 | 0.0474 |
| 250000. | 80.00 | 315.0000 | 0.5303 | 0.5270 | 0.0321 | 0.0497 |
| 250000. | 80.00 | 330.0000 | 0.5240 | 0.5199 | 0.0489 | 0.0441 |
| 250000. | 80.00 | 345.0000 | 0.5210 | 0.5163 | 0.0619 | 0.0327 |
| 250000. | 90.00 | 0. | 0.5502 | 0.5493 | 0 | 0 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 500000. | -90.00 | 0. | 0.5265 | -0.5088 | 0 | 0 |
| 500000. | -80.00 | 0. | 0.4877 | -0.4655 | 0.1330 | 0.0730 |
| 500000. | -80.00 | 15.0000 | 0.4942 | -0.4724 | 0.1118 | 0.0925 |
| 500000. | -80.00 | 30.0000 | 0.5008 | -0.4820 | 0.0866 | 0.1050 |
| 500000. | -80.00 | 45.0000 | 0.5068 | -0.4906 | 0.0606 | 0.1117 |
| 500000. | -80.00 | 60.0000 | 0.5132 | -0.4990 | 0.0343 | 0.1152 |
| 500000. | -80.00 | 75.0000 | 0.5219 | -0.5089 | 0.0064 | 0.1152 |
| 500000. | -80.00 | 90.0000 | 0.5329 | -0.5212 | -0.0223 | 0.1088 |
| 500000. | -80.00 | 105.0000 | 0.5457 | -0.5352 | -0.0477 | 0.0950 |
| 500000. | -80.00 | 120.0000 | 0.5608 | -0.5515 | -0.0677 | 0.0758 |
| 500000. | -80.00 | 135.0000 | 0.5793 | -0.5710 | -0.0836 | 0.0512 |
| 500000. | -80.00 | 150.0000 | 0.5985 | -0.5906 | -0.0957 | 0.0169 |
| 500000. | -80.00 | 165.0000 | 0.6110 | -0.6021 | -0.0998 | -0.0293 |
| 500000. | -80.00 | 180.0000 | 0.6093 | -0.5972 | -0.0896 | -0.0807 |
| 500000. | -80.00 | 195.0000 | 0.5918 | -0.5751 | -0.0633 | -0.1243 |
| 500000. | -80.00 | 210.0000 | 0.5638 | -0.5429 | -0.0260 | -0.1497 |
| 500000. | -80.00 | 225.0000 | 0.5340 | -0.5107 | 0.0151 | -0.1552 |
| 500000. | -80.00 | 240.0000 | 0.5093 | -0.4851 | 0.0542 | -0.1453 |
| 500000. | -80.00 | 255.0000 | 0.4923 | -0.4676 | 0.0887 | -0.1259 |
| 500000. | -80.00 | 270.0000 | 0.4819 | -0.4564 | 0.1174 | -0.1005 |
| 500000. | -80.00 | 285.0000 | 0.4763 | -0.4500 | 0.1388 | -0.0708 |
| 500000. | -80.00 | 300.0000 | 0.4744 | -0.4478 | 0.1517 | -0.0391 |
| 500000. | -80.00 | 315.0000 | 0.4758 | -0.4488 | 0.1567 | -0.0084 |
| 500000. | -80.00 | 330.0000 | 0.4781 | -0.4517 | 0.1554 | 0.0207 |
| 500000. | -80.00 | 345.0000 | 0.4822 | -0.4565 | 0.1478 | 0.0482 |
| 500000. | -70.00 | 0. | 0.4236 | -0.3852 | 0.1620 | 0.0698 |
| 500000. | -70.00 | 15.0000 | 0.4402 | -0.4050 | 0.1461 | 0.0919 |
| 500000. | -70.00 | [illegible] 0000 | 0.4639 | -0.4343 | 0.1249 | 0.1046 |
| 500000. | -70.00 | [illegible]000 | 0.4801 | -0.4579 | 0.1004 | 0.1040 |
| 500000. | -70.00 | [illegible]000 | 0.4883 | -0.4701 | 0.0780 | 0.1064 |
| 500000. | -70.00 | 75.0000 | 0.5102 | -0.4935 | 0.0530 | 0.1181 |
| 500000. | -70.00 | 90.0000 | 0.5489 | -0.5357 | 0.0223 | 0.1172 |
| 500000. | -70.00 | 105.0000 | 0.5818 | -0.5744 | -0.0063 | 0.0928 |
| 500000. | -70.00 | 120.0000 | 0.5969 | -0.5936 | -0.0231 | 0.0584 |
| 500000. | -70.00 | 135.0000 | 0.6027 | -0.6014 | -0.0243 | 0.0312 |
| 500000. | -70.00 | 150.0000 | 0.6180 | -0.6177 | -0.0176 | 0.0118 |
| 500000. | -70.00 | 165.0000 | 0.6440 | -0.6436 | -0.0109 | -0.0211 |
| 500000. | -70.00 | 180.0000 | 0.6540 | -0.6500 | 0.0038 | -0.0720 |
| 500000. | -70.00 | 195.0000 | 0.6366 | -0.6262 | 0.0262 | -0.1118 |
| 500000. | -70.00 | 210.0000 | 0.6046 | -0.5882 | 0.0454 | -0.1323 |
| 500000. | -70.00 | 225.0000 | 0.5642 | -0.5427 | 0.0631 | -0.1407 |
| 500000. | -70.00 | 240.0000 | 0.5216 | -0.4958 | 0.0847 | -0.1380 |
| 500000. | -70.00 | 255.0000 | 0.4853 | -0.4551 | 0.1117 | -0.1264 |
| 500000. | -70.00 | 270.0000 | 0.4560 | -0.4204 | 0.1413 | -0.1061 |
| 500000. | -70.00 | 285.0000 | 0.4357 | -0.3957 | 0.1672 | -0.0728 |
| 500000. | -70.00 | 300.0000 | 0.4304 | -0.3885 | 0.1819 | -0.0358 |
| 500000. | -70.00 | 315.0000 | 0.4302 | -0.3876 | 0.1864 | -0.0082 |
| 500000. | -70.00 | 330.0000 | 0.4239 | -0.3814 | 0.1845 | 0.0158 |
| 500000. | -70.00 | 345.0000 | 0.4187 | -0.3776 | 0.1757 | 0.0433 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 500000. | -60.00 | 0. | 0.3600 | -0.3194 | 0.1518 | 0.0675 |
| 500000. | -60.00 | 15.0000 | 0.3702 | -0.3342 | 0.1395 | 0.0770 |
| 500000. | -60.00 | 30.0000 | 0.3926 | -0.3578 | 0.1333 | 0.0911 |
| 500000. | -60.00 | 45.0000 | 0.4253 | -0.3943 | 0.1240 | 0.1001 |
| 500000. | -60.00 | 60.0000 | 0.4533 | -0.4288 | 0.1048 | 0.1031 |
| 500000. | -60.00 | 75.0000 | 0.4848 | -0.4646 | 0.0860 | 0.1086 |
| 500000. | -60.00 | 90.0000 | 0.5255 | -0.5094 | 0.0742 | 0.1055 |
| 500000. | -60.00 | 105.0000 | 0.5685 | -0.5579 | 0.0622 | 0.0896 |
| 500000. | -60.00 | 120.0000 | 0.6020 | -0.5974 | 0.0506 | 0.0548 |
| 500000. | -60.00 | 135.0000 | 0.6202 | -0.6181 | 0.0462 | 0.0202 |
| 500000. | -60.00 | 150.0000 | 0.6336 | -0.6310 | 0.0571 | -0.0066 |
| 500000. | -60.00 | 165.0000 | 0.6563 | -0.6505 | 0.0789 | -0.0370 |
| 500000. | -60.00 | 180.0000 | 0.6458 | -0.6310 | 0.1050 | -0.0887 |
| 500000. | -60.00 | 195.0000 | 0.5987 | -0.5741 | 0.1289 | -0.1103 |
| 500000. | -60.00 | 210.0000 | 0.5596 | -0.5287 | 0.1470 | -0.1099 |
| 500000. | -60.00 | 225.0000 | 0.5323 | -0.4989 | 0.1537 | -0.1037 |
| 500000. | -60.00 | 240.0000 | 0.5098 | -0.4744 | 0.1522 | -0.1083 |
| 500000. | -60.00 | 255.0000 | 0.4753 | -0.4323 | 0.1612 | -0.1142 |
| 500000. | -60.00 | 270.0000 | 0.4346 | -0.3826 | 0.1774 | -0.1049 |
| 500000. | -60.00 | 285.0000 | 0.3960 | -0.3352 | 0.1958 | -0.0783 |
| 500000. | -60.00 | 300.0000 | 0.3725 | -0.3057 | 0.2095 | -0.0383 |
| 500000. | -60.00 | 315.0000 | 0.3592 | -0.2927 | 0.2082 | -0.0001 |
| 500000. | -60.00 | 330.0000 | 0.3509 | -0.2933 | 0.1904 | 0.0300 |
| 500000. | -60.00 | 345.0000 | 0.3504 | -0.3018 | 0.1700 | 0.0529 |
| 500000. | -50.00 | 0. | 0.3117 | -0.2714 | 0.1374 | 0.0677 |
| 500000. | -50.00 | 15.0000 | 0.3300 | -0.2964 | 0.1267 | 0.0707 |
| 500000. | -50.00 | 30.0000 | 0.3521 | -0.3213 | 0.1244 | 0.0726 |
| 500000. | -50.00 | 45.0000 | 0.3773 | -0.3459 | 0.1253 | 0.0834 |
| 500000. | -50.00 | 60.0000 | 0.4135 | -0.3837 | 0.1219 | 0.0945 |
| 500000. | -50.00 | 75.0000 | 0.4572 | -0.4325 | 0.1037 | 0.1009 |
| 500000. | -50.00 | 90.0000 | 0.5005 | -0.4825 | 0.0954 | 0.0928 |
| 500000. | -50.00 | 105.0000 | 0.5504 | -0.5372 | 0.0915 | 0.0779 |
| 500000. | -50.00 | 120.0000 | 0.5887 | -0.5790 | 0.0985 | 0.0390 |
| 500000. | -50.00 | 135.0000 | 0.6082 | -0.5976 | 0.1132 | 0.0044 |
| 500000. | -50.00 | 150.0000 | 0.6009 | -0.5837 | 0.1382 | -0.0358 |
| 500000. | -50.00 | 165.0000 | 0.5916 | -0.5666 | 0.1619 | -0.0522 |
| 500000. | -50.00 | 180.0000 | 0.5724 | -0.5393 | 0.1739 | -0.0809 |
| 500000. | -50.00 | 195.0000 | 0.5407 | -0.5028 | 0.1760 | -0.0927 |
| 500000. | -50.00 | 210.0000 | 0.5009 | -0.4590 | 0.1764 | -0.0954 |
| 500000. | -50.00 | 225.0000 | 0.4707 | -0.4252 | 0.1823 | -0.0868 |
| 500000. | -50.00 | 240.0000 | 0.4573 | -0.4048 | 0.1928 | -0.0897 |
| 500000. | -50.00 | 255.0000 | 0.4268 | -0.3644 | 0.1986 | -0.0997 |
| 500000. | -50.00 | 270.0000 | 0.3860 | -0.3119 | 0.2068 | -0.0946 |
| 500000. | -50.00 | 285.0000 | 0.3423 | -0.2560 | 0.2152 | -0.0728 |
| 500000. | -50.00 | 300.0000 | 0.3082 | -0.2201 | 0.2139 | -0.0274 |
| 500000. | -50.00 | 315.0000 | 0.2930 | -0.2153 | 0.1980 | 0.0172 |
| 500000. | -50.00 | 330.0000 | 0.2947 | -0.2311 | 0.1771 | 0.0456 |
| 500000. | -50.00 | 345.0000 | 0.2988 | -0.2486 | 0.1539 | 0.0613 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 500000. | -40.00 | 0. | 0.2845 | -0.2474 | 0.1235 | 0.0673 |
| 500000. | -40.00 | 15.0000 | 0.3058 | -0.2741 | 0.1225 | 0.0582 |
| 500000. | -40.00 | 30.0000 | 0.3187 | -0.2857 | 0.1284 | 0.0590 |
| 500000. | -40.00 | 45.0000 | 0.3453 | -0.3123 | 0.1301 | 0.0689 |
| 500000. | -40.00 | 60.0000 | 0.3839 | -0.3492 | 0.1369 | 0.0819 |
| 500000. | -40.00 | 75.0000 | 0.4408 | -0.4080 | 0.1397 | 0.0915 |
| 500000. | -40.00 | 90.0000 | 0.4960 | -0.4684 | 0.1413 | 0.0815 |
| 500000. | -40.00 | 105.0000 | 0.5402 | -0.5159 | 0.1500 | 0.0561 |
| 500000. | -40.00 | 120.0000 | 0.5696 | -0.5451 | 0.1638 | 0.0215 |
| 500000. | -40.00 | 135.0000 | 0.5803 | -0.5513 | 0.1809 | -0.0109 |
| 500000. | -40.00 | 150.0000 | 0.5641 | -0.5302 | 0.1879 | -0.0426 |
| 500000. | -40.00 | 165.0000 | 0.5494 | -0.5091 | 0.1983 | -0.0575 |
| 500000. | -40.00 | 180.0000 | 0.5238 | -0.4730 | 0.2113 | -0.0775 |
| 500000. | -40.00 | 195.0000 | 0.4854 | -0.4247 | 0.2203 | -0.0819 |
| 500000. | -40.00 | 210.0000 | 0.4610 | -0.3985 | 0.2187 | -0.0770 |
| 500000. | -40.00 | 225.0000 | 0.4370 | -0.3682 | 0.2215 | -0.0796 |
| 500000. | -40.00 | 240.0000 | 0.4111 | -0.3342 | 0.2253 | -0.0808 |
| 500000. | -40.00 | 255.0000 | 0.3805 | -0.2946 | 0.2251 | -0.0854 |
| 500000. | -40.00 | 270.0000 | 0.3388 | -0.2419 | 0.2224 | -0.0823 |
| 500000. | -40.00 | 285.0000 | 0.2927 | -0.1877 | 0.2164 | -0.0600 |
| 500000. | -40.00 | 300.0000 | 0.2582 | -0.1533 | 0.2073 | -0.0142 |
| 500000. | -40.00 | 315.0000 | 0.2502 | -0.1568 | 0.1925 | 0.0308 |
| 500000. | -40.00 | 330.0000 | 0.2554 | -0.1818 | 0.1686 | 0.0612 |
| 500000. | -40.00 | 345.0000 | 0.2690 | -0.2181 | 0.1403 | 0.0714 |
| | | | | | | |
| 500000. | -30.00 | 0. | 0.2836 | -0.2463 | 0.1241 | 0.0661 |
| 500000. | -30.00 | 15.0000 | 0.2898 | -0.2574 | 0.1254 | 0.0448 |
| 500000. | -30.00 | 30.0000 | 0.3050 | -0.2705 | 0.1311 | 0.0520 |
| 500000. | -30.00 | 45.0000 | 0.3339 | -0.2965 | 0.1456 | 0.0489 |
| 500000. | -30.00 | 60.0000 | 0.3641 | -0.3197 | 0.1617 | 0.0650 |
| 500000. | -30.00 | 75.0000 | 0.4155 | -0.3681 | 0.1778 | 0.0746 |
| 500000. | -30.00 | 90.0000 | 0.4682 | -0.4230 | 0.1907 | 0.0630 |
| 500000. | -30.00 | 105.0000 | 0.5099 | -0.4638 | 0.2082 | 0.0393 |
| 500000. | -30.00 | 120.0000 | 0.5325 | -0.4786 | 0.2334 | 0.0017 |
| 500000. | -30.00 | 135.0000 | 0.5293 | -0.4653 | 0.2516 | -0.0198 |
| 500000. | -30.00 | 150.0000 | 0.5220 | -0.4516 | 0.2586 | -0.0409 |
| 500000. | -30.00 | 165.0000 | 0.5011 | -0.4205 | 0.2660 | -0.0595 |
| 500000. | -30.00 | 180.0000 | 0.4708 | -0.3815 | 0.2669 | -0.0698 |
| 500000. | -30.00 | 195.0000 | 0.4383 | -0.3467 | 0.2584 | -0.0712 |
| 500000. | -30.00 | 210.0000 | 0.4153 | -0.3138 | 0.2625 | -0.0713 |
| 500000. | -30.00 | 225.0000 | 0.3872 | -0.2787 | 0.2597 | -0.0697 |
| 500000. | -30.00 | 240.0000 | 0.3611 | -0.2497 | 0.2518 | -0.0683 |
| 500000. | -30.00 | 255.0000 | 0.3352 | -0.2177 | 0.2446 | -0.0717 |
| 500000. | -30.00 | 270.0000 | 0.3015 | -0.1719 | 0.2382 | -0.0681 |
| 500000. | -30.00 | 285.0000 | 0.2657 | -0.1265 | 0.2291 | -0.0455 |
| 500000. | -30.00 | 300.0000 | 0.2374 | -0.1013 | 0.2147 | -0.0008 |
| 500000. | -30.00 | 315.0000 | 0.2286 | -0.1143 | 0.1931 | 0.0439 |
| 500000. | -30.00 | 330.0000 | 0.2389 | -0.1520 | 0.1680 | 0.0757 |
| 500000. | -30.00 | 345.0000 | 0.2642 | -0.2062 | 0.1435 | 0.0816 |

| H (feet) | TH (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 500000. | -20.00 | 0. | 0.2961 | -0.2394 | 0.1602 | 0.0687 |
| 500000. | -20.00 | 15.0000 | 0.3026 | -0.2572 | 0.1545 | 0.0393 |
| 500000. | -20.00 | 30.0000 | 0.3121 | -0.2616 | 0.1665 | 0.0353 |
| 500000. | -20.00 | 45.0000 | 0.3300 | -0.2695 | 0.1876 | 0.0335 |
| 500000. | -20.00 | 60.0000 | 0.3548 | -0.2862 | 0.2044 | 0.0464 |
| 500000. | -20.00 | 75.0000 | 0.3906 | -0.3743 | 0.2250 | 0.0560 |
| 500000. | -20.00 | 90.0000 | 0.4380 | -0.3606 | 0.2446 | 0.0451 |
| 500000. | -20.00 | 105.0000 | 0.4690 | -0.3811 | 0.2728 | 0.0165 |
| 500000. | -20.00 | 120.0000 | 0.4753 | -0.3733 | 0.2940 | -0.0103 |
| 500000. | -20.00 | 135.0000 | 0.4678 | -0.3575 | 0.3007 | -0.0247 |
| 500000. | -20.00 | 150.0000 | 0.4563 | -0.3383 | 0.3035 | -0.0406 |
| 500000. | -20.00 | 165.0000 | 0.4352 | -0.3075 | 0.3004 | -0.0537 |
| 500000. | -20.00 | 180.0000 | 0.4088 | -0.2724 | 0.2980 | -0.064[illegible] |
| 500000. | -20.00 | 195.0000 | 0.3900 | -0.2417 | 0.2994 | -0.0634 |
| 500000. | -20.00 | 210.0000 | 0.3629 | -0.2081 | 0.2908 | -0.0617 |
| 500000. | -20.00 | 225.0000 | 0.3407 | -0.1818 | 0.2818 | -0.0600 |
| 500000. | -20.00 | 240.0000 | 0.3235 | -0.1597 | 0.2755 | -0.0571 |
| 500000. | -20.00 | 255.0000 | 0.3042 | -0.1325 | 0.2670 | -0.0608 |
| 500000. | -20.00 | 270.0000 | 0.2797 | -0.0957 | 0.2569 | -0.0556 |
| 500000. | -20.00 | 285.0000 | 0.2560 | -0.0584 | 0.2469 | -0.0339 |
| 500000. | -20.00 | 300.0000 | 0.2363 | -0.0442 | 0.2318 | 0.0118 |
| 500000. | -20.00 | 315.0000 | 0.2313 | -0.0659 | 0.2144 | 0.0565 |
| 500000. | -20.00 | 330.0000 | 0.2422 | -0.1158 | 0.1951 | 0.0847 |
| 500000. | -20.00 | 345.0000 | 0.2677 | -0.1823 | 0.1732 | 0.0918 |
| 500000. | -10.00 | 0. | 0.2951 | -0.1926 | 0.2137 | 0.0654 |
| 500000. | -10.00 | 15.0000 | 0.3116 | -0.2191 | 0.2184 | 0.0371 |
| 500000. | -10.00 | 30.0000 | 0.3170 | -0.2193 | 0.2279 | 0.0213 |
| 500000. | -10.00 | 45.0000 | 0.3246 | -0.2104 | 0.2464 | 0.0182 |
| 500000. | -10.00 | 60.0000 | 0.3449 | -0.2180 | 0.2651 | 0.0330 |
| 500000. | -10.00 | 75.0000 | 0.3716 | -0.2392 | 0.2815 | 0.0403 |
| 500000. | -10.00 | 90.0000 | 0.4061 | -0.2715 | 0.3006 | 0.0291 |
| 500000. | -10.00 | 105.0000 | 0.4175 | -0.2720 | 0.3167 | -0.0008 |
| 500000. | -10.00 | 120.0000 | 0.4153 | -0.2473 | 0.3331 | -0.0194 |
| 500000. | -10.00 | 135.0000 | 0.4085 | -0.2265 | 0.3392 | -0.0242 |
| 500000. | -10.00 | 150.0000 | 0.3967 | -0.2103 | 0.3345 | -0.0356 |
| 500000. | -10.00 | 165.0000 | 0.3816 | -0.1852 | 0.3298 | -0.0499 |
| 500000. | -10.00 | 180.0000 | 0.3627 | -0.1515 | 0.3245 | -0.0574 |
| 500000. | -10.00 | 195.0000 | 0.3397 | -0.1220 | 0.3122 | -0.0553 |
| 500000. | -10.00 | 210.0000 | 0.3233 | -0.0985 | 0.3033 | -0.0532 |
| 500000. | -10.00 | 225.0000 | 0.3096 | -0.0803 | 0.2947 | -0.0507 |
| 500000. | -10.00 | 240.0000 | 0.2975 | -0.0626 | 0.2865 | -0.0502 |
| 500000. | -10.00 | 255.0000 | 0.2903 | -0.0419 | 0.2824 | -0.0527 |
| 500000. | -10.00 | 270.0000 | 0.2825 | -0.0084 | 0.2781 | -0.0487 |
| 500000. | -10.00 | 285.0000 | 0.2717 | 0.0249 | 0.2695 | -0.0246 |
| 500000. | -10.00 | 300.0000 | 0.2606 | 0.0346 | 0.2573 | 0.0228 |
| 500000. | -10.00 | 315.0000 | 0.2480 | 0.0008 | 0.2391 | 0.0660 |
| 500000. | -10.00 | 330.0000 | 0.2469 | -0.0588 | 0.2208 | 0.0935 |
| 500000. | -10.00 | 345.0000 | 0.2700 | -0.1363 | 0.2123 | 0.0962 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 500000. | 0.00 | 0. | 0.2896 | -0.1154 | 0.2592 | 0.0581 |
| 500000. | 0.00 | 15.0000 | 0.3058 | -0.1289 | 0.2758 | 0.0292 |
| 500000. | 0.00 | 30.0000 | 0.3146 | -0.1265 | 0.2878 | 0.0118 |
| 500000. | 0.00 | 45.0000 | 0.3195 | -0.1107 | 0.2996 | 0.0077 |
| 500000. | 0.00 | 60.0000 | 0.3349 | -0.1075 | 0.3165 | 0.0202 |
| 500000. | 0.00 | 75.0000 | 0.3553 | -0.1236 | 0.3319 | 0.0286 |
| 500000. | 0.00 | 90.0000 | 0.3781 | -0.1460 | 0.3483 | 0.0179 |
| 500000. | 0.00 | 105.0000 | 0.3864 | -0.1387 | 0.3606 | -0.0084 |
| 500000. | 0.00 | 120.0000 | 0.3744 | -0.1103 | 0.3572 | -0.0205 |
| 500000. | 0.00 | 135.0000 | 0.3594 | -0.0908 | 0.3471 | -0.0202 |
| 500000. | 0.00 | 150.0000 | 0.3472 | -0.0786 | 0.3370 | -0.0289 |
| 500000. | 0.00 | 165.0000 | 0.3332 | -0.0571 | 0.3251 | -0.0458 |
| 500000. | 0.00 | 180.0000 | 0.3209 | -0.0260 | 0.3159 | -0.0499 |
| 500000. | 0.00 | 195.0000 | 0.3167 | -0.0014 | 0.3128 | -0.0496 |
| 500000. | 0.00 | 210.0000 | 0.3088 | 0.0136 | 0.3049 | -0.0469 |
| 500000. | 0.00 | 225.0000 | 0.3036 | 0.0256 | 0.2992 | -0.0447 |
| 500000. | 0.00 | 240.0000 | 0.3052 | 0.0384 | 0.2989 | -0.0481 |
| 500000. | 0.00 | 255.0000 | 0.3067 | 0.0612 | 0.2965 | -0.0491 |
| 500000. | 0.00 | 270.0000 | 0.3092 | 0.0942 | 0.2911 | -0.0447 |
| 500000. | 0.00 | 285.0000 | 0.3114 | 0.1278 | 0.2835 | -0.0161 |
| 500000. | 0.00 | 300.0000 | 0.2987 | 0.1285 | 0.2673 | 0.0317 |
| 500000. | 0.00 | 315.0000 | 0.2830 | 0.0878 | 0.2587 | 0.0739 |
| 500000. | 0.00 | 330.0000 | 0.2722 | 0.0182 | 0.2525 | 0.1001 |
| 500000. | 0.00 | 345.0000 | 0.2729 | -0.0635 | 0.2483 | 0.0937 |
| 500000. | 10.00 | 0. | 0.2981 | -0.0055 | 0.2944 | 0.0463 |
| 500000. | 10.00 | 15.0000 | 0.3088 | -0.0081 | 0.3079 | 0.0211 |
| 500000. | 10.00 | 30.0000 | 0.3195 | 0.0024 | 0.3194 | 0.0046 |
| 500000. | 10.00 | 45.0000 | 0.3278 | 0.0165 | 0.3274 | 0.0008 |
| 500000. | 10.00 | 60.0000 | 0.3413 | 0.0269 | 0.3402 | 0.0086 |
| 500000. | 10.00 | 75.0000 | 0.3586 | 0.0176 | 0.3577 | 0.0179 |
| 500000. | 10.00 | 90.0000 | 0.3731 | 0.0057 | 0.3729 | 0.0105 |
| 500000. | 10.00 | 105.0000 | 0.3704 | 0.0119 | 0.3702 | -0.0077 |
| 500000. | 10.00 | 120.0000 | 0.3623 | 0.0290 | 0.3609 | -0.0123 |
| 500000. | 10.00 | 135.0000 | 0.3476 | 0.0379 | 0.3453 | -0.0114 |
| 500000. | 10.00 | 150.0000 | 0.3290 | 0.0417 | 0.3258 | -0.0198 |
| 500000. | 10.00 | 165.0000 | 0.3192 | 0.0577 | 0.3116 | -0.0380 |
| 500000. | 10.00 | 180.0000 | 0.3117 | 0.0808 | 0.2978 | -0.0439 |
| 500000. | 10.00 | 195.0000 | 0.3089 | 0.1023 | 0.2876 | -0.0472 |
| 500000. | 10.00 | 210.0000 | 0.3152 | 0.1182 | 0.2886 | -0.0459 |
| 500000. | 10.00 | 225.0000 | 0.3244 | 0.1315 | 0.2928 | -0.0469 |
| 500000. | 10.00 | 240.0000 | 0.3347 | 0.1508 | 0.2949 | -0.0486 |
| 500000. | 10.00 | 255.0000 | 0.3465 | 0.1748 | 0.2952 | -0.0484 |
| 500000. | 10.00 | 270.0000 | 0.3604 | 0.2082 | 0.2914 | -0.0410 |
| 500000. | 10.00 | 285.0000 | 0.3666 | 0.2386 | 0.2782 | -0.0063 |
| 500000. | 10.00 | 300.0000 | 0.3520 | 0.2286 | 0.2647 | 0.0402 |
| 500000. | 10.00 | 315.0000 | 0.3277 | 0.1862 | 0.2584 | 0.0772 |
| 500000 | 10.00 | 330.0000 | 0.3032 | 0.1150 | 0.2614 | 0.1019 |
| 500000. | 10.00 | 345.0000 | 0.2910 | 0.0301 | 0.2756 | 0.0883 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 500000. | 20.00 | 0. | 0.3267 | 0.1201 | 0.3014 | 0.0363 |
| 500000. | 20.00 | 15.0000 | 0.3330 | 0.1218 | 0.3094 | 0.0173 |
| 500000. | 20.00 | 30.0000 | 0.3448 | 0.1359 | 0.3168 | -0.0026 |
| 500000. | 20.00 | 45.0000 | 0.3594 | 0.1518 | 0.3257 | -0.0066 |
| 500000. | 20.00 | 60.0000 | 0.3771 | 0.1676 | 0.3378 | -0.0005 |
| 500000. | 20.00 | 75.0000 | 0.3928 | 0.1703 | 0.3540 | 0.0058 |
| 500000. | 20.00 | 90.0000 | 0.4018 | 0.1673 | 0.3653 | 0.0062 |
| 500000. | 20.00 | 105.0000 | 0.4003 | 0.1637 | 0.3653 | -0.0019 |
| 500000. | 20.00 | 120.0000 | 0.3902 | 0.1715 | 0.3505 | -0.0008 |
| 500000. | 20.00 | 135.0000 | 0.3650 | 0.1613 | 0.3274 | 0.0035 |
| 500000. | 20.00 | 150.0000 | 0.3404 | 0.1470 | 0.3070 | -0.0068 |
| 500000. | 20.00 | 165.0000 | 0.3221 | 0.1500 | 0.2837 | -0.0273 |
| 500000. | 20.00 | 180.0000 | 0.3214 | 0.1687 | 0.2707 | -0.0392 |
| 500000. | 20.00 | 195.0000 | 0.3315 | 0.1900 | 0.2674 | -0.0479 |
| 500000. | 20.00 | 210.0000 | 0.3433 | 0.2096 | 0.2670 | -0.0510 |
| 500000. | 20.00 | 225.0000 | 0.3633 | 0.2336 | 0.2733 | -0.0526 |
| 500000. | 20.00 | 240.0000 | 0.3862 | 0.2600 | 0.2805 | -0.0536 |
| 500000. | 20.00 | 255.0000 | 0.4070 | 0.2895 | 0.2815 | -0.0501 |
| 500000. | 20.00 | 270.0000 | 0.4241 | 0.3245 | 0.2709 | -0.0335 |
| 500000. | 20.00 | 285.0000 | 0.4258 | 0.3424 | 0.2530 | 0.0053 |
| 500000. | 20.00 | 300.0000 | 0.4052 | 0.3217 | 0.2416 | 0.0479 |
| 500000. | 20.00 | 315.0000 | 0.3725 | 0.2726 | 0.2412 | 0.0793 |
| 500000. | 20.00 | 330.0000 | 0.3429 | 0.2086 | 0.2545 | 0.0964 |
| 500000. | 20.00 | 345.0000 | 0.3261 | 0.1452 | 0.2823 | 0.0744 |
| 500000. | 30.00 | 0. | 0.3692 | 0.2440 | 0.2754 | 0.0309 |
| 500000. | 30.00 | 15.0000 | 0.3742 | 0.2432 | 0.2840 | 0.0149 |
| 500000. | 30.00 | 30.0000 | 0.3860 | 0.2575 | 0.2875 | -0.0071 |
| 500000. | 30.00 | 45.0000 | 0.4045 | 0.2776 | 0.2939 | -0.0143 |
| 500000. | 30.00 | 60.0000 | 0.4253 | 0.2988 | 0.3024 | -0.0101 |
| 500000. | 30.00 | 75.0000 | 0.4381 | 0.3075 | 0.3121 | -0.0034 |
| 500000. | 30.00 | 90.0000 | 0.4481 | 0.3099 | 0.3236 | 0.0010 |
| 500000. | 30.00 | 105.0000 | 0.4492 | 0.3087 | 0.3263 | 0.0028 |
| 500000. | 30.00 | 120.0000 | 0.4362 | 0.3009 | 0.3155 | 0.0124 |
| 500000. | 30.00 | 135.0000 | 0.4121 | 0.2775 | 0.3042 | 0.0179 |
| 500000. | 30.00 | 150.0000 | 0.3803 | 0.2505 | 0.2860 | 0.0084 |
| 500000. | 30.00 | 165.0000 | 0.3573 | 0.2354 | 0.2685 | -0.0131 |
| 500000. | 30.00 | 180.0000 | 0.3495 | 0.2416 | 0.2500 | -0.0353 |
| 500000. | 30.00 | 195.0000 | 0.3627 | 0.2649 | 0.2426 | -0.0500 |
| 500000. | 30.00 | 210.0000 | 0.3832 | 0.2911 | 0.2425 | -0.0572 |
| 500000. | 30.00 | 225.0000 | 0.4120 | 0.3254 | 0.2449 | -0.0629 |
| 500000. | 30.00 | 240.0000 | 0.4413 | 0.3619 | 0.2453 | -0.0593 |
| 500000. | 30.00 | 255.0000 | 0.4696 | 0.3990 | 0.2424 | -0.0497 |
| 500000. | 30.00 | 270.0000 | 0.4839 | 0.4249 | 0.2304 | -0.0237 |
| 500000. | 30.00 | 285.0000 | 0.4802 | 0.4288 | 0.2156 | 0.0157 |
| 500000. | 30.00 | 300.0000 | 0.4570 | 0.4023 | 0.2098 | 0.0551 |
| 500000. | 30.00 | 315.0000 | 0.4225 | 0.3544 | 0.2156 | 0.0798 |
| 500000. | 30.00 | 330.0000 | 0.3845 | 0.2933 | 0.2342 | 0.0835 |
| 500000. | 30.00 | 345.0000 | 0.3728 | 0.2578 | 0.2616 | 0.0640 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 500000. | 40.00 | 0. | 0.4048 | 0.3333 | 0.2280 | 0.0234 |
| 500000. | 40.00 | 15.0000 | 0.4094 | 0.3356 | 0.2343 | 0.0094 |
| 500000. | 40.00 | 30.0000 | 0.4244 | 0.3507 | 0.2388 | -0.0088 |
| 500000. | 40.00 | 45.0000 | 0.4412 | 0.3701 | 0.2392 | -0.0207 |
| 500000. | 40.00 | 60.0000 | 0.4653 | 0.3950 | 0.2450 | -0.0201 |
| 500000. | 40.00 | 75.0000 | 0.4848 | 0.4114 | 0.2563 | -0.0130 |
| 500000. | 40.00 | 90.0000 | 0.5010 | 0.4249 | 0.2654 | -0.0087 |
| 500000. | 40.00 | 105.0000 | 0.5095 | 0.4302 | 0.2729 | 0.0059 |
| 500000. | 40.00 | 120.0000 | 0.4950 | 0.4140 | 0.2706 | 0.0214 |
| 500000. | 40.00 | 135.0000 | 0.4633 | 0.3811 | 0.2615 | 0.0316 |
| 500000. | 40.00 | 150.0000 | 0.4256 | 0.3393 | 0.2525 | 0.0221 |
| 500000. | 40.00 | 165.0000 | 0.3998 | 0.3176 | 0.2428 | -0.0021 |
| 500000. | 40.00 | 180.0000 | 0.3924 | 0.3143 | 0.2329 | -0.0308 |
| 500000. | 40.00 | 195.0000 | 0.4083 | 0.3382 | 0.2232 | -0.0504 |
| 500000. | 40.00 | 210.0000 | 0.4316 | 0.3676 | 0.2169 | -0.0642 |
| 500000. | 40.00 | 225.0000 | 0.4629 | 0.4062 | 0.2112 | -0.0687 |
| 500000. | 40.00 | 240.0000 | 0.4946 | 0.4464 | 0.2032 | -0.0634 |
| 500000. | 40.00 | 255.0000 | 0.5231 | 0.4849 | 0.1906 | -0.0466 |
| 500000. | 40.00 | 270.0000 | 0.5343 | 0.5049 | 0.1742 | -0.0131 |
| 500000. | 40.00 | 285.0000 | 0.5238 | 0.4968 | 0.1643 | 0.0246 |
| 500000. | 40.00 | 300.0000 | 0.4947 | 0.4629 | 0.1634 | 0.0612 |
| 500000. | 40.00 | 315.0000 | 0.4626 | 0.4202 | 0.1783 | 0.0752 |
| 500000. | 40.00 | 330.0000 | 0.4334 | 0.3766 | 0.2026 | 0.0701 |
| 500000. | 40.00 | 345.0000 | 0.4204 | 0.3539 | 0.2187 | 0.0608 |
| 500000. | 50.00 | 0. | 0.4384 | 0.3977 | 0.1824 | 0.0270 |
| 500000. | 50.00 | 15.0000 | 0.4438 | 0.4015 | 0.1892 | 0.0061 |
| 500000. | 50.00 | 30.0000 | 0.4531 | 0.4123 | 0.1877 | -0.0109 |
| 500000. | 50.00 | 45.0000 | 0.4724 | 0.4325 | 0.1883 | -0.0250 |
| 500000. | 50.00 | 60.0000 | 0.4979 | 0.4606 | 0.1865 | -0.0303 |
| 500000. | 50.00 | 75.0000 | 0.5206 | 0.4840 | 0.1902 | -0.0233 |
| 500000. | 50.00 | 90.0000 | 0.5390 | 0.5016 | 0.1968 | -0.0166 |
| 500000. | 50.00 | 105.0000 | 0.5464 | 0.5100 | 0.1960 | 0.0047 |
| 500000. | 50.00 | 120.0000 | 0.5366 | 0.4964 | 0.2023 | 0.0227 |
| 500000. | 50.00 | 135.0000 | 0.5152 | 0.4668 | 0.2150 | 0.0365 |
| 500000. | 50.00 | 150.0000 | 0.4827 | 0.4271 | 0.2232 | 0.0280 |
| 500000. | 50.00 | 165.0000 | 0.4622 | 0.4049 | 0.2228 | 0.0062 |
| 500000. | 50.00 | 180.0000 | 0.4463 | 0.3934 | 0.2097 | -0.0219 |
| 500000. | 50.00 | 195.0000 | 0.4532 | 0.4074 | 0.1928 | -0.0476 |
| 500000. | 50.00 | 210.0000 | 0.4741 | 0.4344 | 0.1776 | -0.0667 |
| 500000. | 50.00 | 225.0000 | 0.5072 | 0.4749 | 0.1638 | -0.0700 |
| 500000. | 50.00 | 240.0000 | 0.5357 | 0.5114 | 0.1472 | -0.0614 |
| 500000. | 50.00 | 255.0000 | 0.5545 | 0.5388 | 0.1264 | -0.0345 |
| 500000. | 50.00 | 270.0000 | 0.5520 | 0.5413 | 0.1082 | -0.0022 |
| 500000. | 50.00 | 285.0000 | 0.5431 | 0.5323 | 0.1039 | 0.0294 |
| 500000. | 50.00 | 300.0000 | 0.5205 | 0.5034 | 0.1180 | 0.0598 |
| 500000. | 50.00 | 315.0000 | 0.4906 | 0.4670 | 0.1327 | 0.0706 |
| 500000. | 50.00 | 330.0000 | 0.4624 | 0.4328 | 0.1481 | 0.0676 |
| 500000. | 50.00 | 345.0000 | 0.4431 | 0.4078 | 0.1654 | 0.0520 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 500000. | 60.00 | 0. | 0.4633 | 0.4418 | 0.1377 | 0.0234 |
| 500000. | 60.00 | 15.0000 | 0.4682 | 0.4464 | 0.1411 | 0.0053 |
| 500000. | 60.00 | 30.0000 | 0.4760 | 0.4546 | 0.1406 | -0.0114 |
| 500000. | 60.00 | 45.0000 | 0.4892 | 0.4702 | 0.1328 | -0.0245 |
| 500000. | 60.00 | 60.0000 | 0.5043 | 0.4872 | 0.1260 | -0.0342 |
| 500000. | 60.00 | 75.0000 | 0.5344 | 0.5179 | 0.1254 | -0.0399 |
| 500000. | 60.00 | 90.0000 | 0.5645 | 0.5492 | 0.1281 | -0.0247 |
| 500000. | 60.00 | 105.0000 | 0.5705 | 0.5539 | 0.1365 | -0.0013 |
| 500000. | 60.00 | 120.0000 | 0.5707 | 0.5512 | 0.1474 | 0.0139 |
| 500000. | 60.00 | 135.0000 | 0.5565 | 0.5334 | 0.1549 | 0.0335 |
| 500000. | 60.00 | 150.0000 | 0.5260 | 0.4997 | 0.1619 | 0.0283 |
| 500000. | 60.00 | 165.0000 | 0.5081 | 0.4802 | 0.1657 | 0.0109 |
| 500000. | 60.00 | 180.0000 | 0.4936 | 0.4643 | 0.1669 | -0.0133 |
| 500000. | 60.00 | 195.0000 | 0.4976 | 0.4704 | 0.1571 | -0.0417 |
| 500000. | 60.00 | 210.0000 | 0.5131 | 0.4905 | 0.1384 | -0.0595 |
| 500000. | 60.00 | 225.0000 | 0.5363 | 0.5205 | 0.1126 | -0.0633 |
| 500000. | 60.00 | 240.0000 | 0.5542 | 0.5449 | 0.0884 | -0.0494 |
| 500000. | 60.00 | 255.0000 | 0.5633 | 0.5584 | 0.0714 | -0.0221 |
| 500000. | 60.00 | 270.0000 | 0.5528 | 0.5490 | 0.0636 | 0.0117 |
| 500000. | 60.00 | 285.0000 | 0.5352 | 0.5307 | 0.0616 | 0.0316 |
| 500000. | 60.00 | 300.0000 | 0.5274 | 0.5201 | 0.0697 | 0.0521 |
| 500000. | 60.00 | 315.0000 | 0.5040 | 0.4913 | 0.0885 | 0.0692 |
| 500000. | 60.00 | 330.0000 | 0.4777 | 0.4607 | 0.1101 | 0.0613 |
| 500000. | 60.00 | 345.0000 | 0.4666 | 0.4465 | 0.1281 | 0.0440 |
| 500000. | 70.00 | 0. | 0.4851 | 0.4742 | 0.1001 | 0.0217 |
| 500000. | 70.00 | 15.0000 | 0.4880 | 0.4768 | 0.1039 | 0.0062 |
| 500000. | 70.00 | 30.0000 | 0.4911 | 0.4803 | 0.1023 | -0.0070 |
| 500000. | 70.00 | 45.0000 | 0.4951 | 0.4849 | 0.0977 | -0.0213 |
| 500000. | 70.00 | 60.0000 | 0.5079 | 0.4984 | 0.0900 | -0.0376 |
| 500000. | 70.00 | 75.0000 | 0.5325 | 0.5247 | 0.0781 | -0.0458 |
| 500000. | 70.00 | 90.0000 | 0.5583 | 0.5528 | 0.0686 | -0.0377 |
| 500000. | 70.00 | 105.0000 | 0.5776 | 0.5732 | 0.0678 | -0.0201 |
| 500000. | 70.00 | 120.0000 | 0.5862 | 0.5816 | 0.0737 | 0.0033 |
| 500000. | 70.00 | 135.0000 | 0.5754 | 0.5681 | 0.0879 | 0.0242 |
| 500000. | 70.00 | 150.0000 | 0.5541 | 0.5436 | 0.1048 | 0.0234 |
| 500000. | 70.00 | 165.0000 | 0.5403 | 0.5283 | 0.1129 | 0.0077 |
| 500000. | 70.00 | 180.0000 | 0.5336 | 0.5217 | 0.1114 | -0.0110 |
| 500000. | 70.00 | 195.0000 | 0.5320 | 0.5217 | 0.0999 | -0.0291 |
| 500000. | 70.00 | 210.0000 | 0.5357 | 0.5279 | 0.0810 | -0.0415 |
| 500000. | 70.00 | 225.0000 | 0.5436 | 0.5385 | 0.0595 | -0.0444 |
| 500000. | 70.00 | 240.0000 | 0.5536 | 0.5510 | 0.0399 | -0.0354 |
| 500000. | 70.00 | 255.0000 | 0.5613 | 0.5605 | 0.0260 | -0.0136 |
| 500000. | 70.00 | 270.0000 | 0.5576 | 0.5569 | 0.0230 | 0.0160 |
| 500000. | 70.00 | 285.0000 | 0.5429 | 0.5407 | 0.0294 | 0.0384 |
| 500000. | 70.00 | 300.0000 | 0.5266 | 0.5224 | 0.0398 | 0.0528 |
| 500000. | 70.00 | 315.0000 | 0.5085 | 0.5018 | 0.0566 | 0.0599 |
| 500000. | 70.00 | 330.0000 | 0.4929 | 0.4842 | 0.0755 | 0.0528 |
| 500000. | 70.00 | 345.0000 | 0.4859 | 0.4760 | 0.0902 | 0.0381 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 500000. | 80.00 | 0. | 0.5058 | 0.5010 | 0.0671 | 0.0192 |
| 500000. | 80.00 | 15.0000 | 0.5077 | 0.5027 | 0.0709 | 0.0060 |
| 500000. | 80.00 | 30.0000 | 0.5107 | 0.5057 | 0.0711 | -0.0071 |
| 500000. | 80.00 | 45.0000 | 0.5154 | 0.5106 | 0.0674 | -0.0201 |
| 500000. | 80.00 | 60.0000 | 0.5228 | 0.5185 | 0.0590 | -0.0314 |
| 500000. | 80.00 | 75.0000 | 0.5329 | 0.5295 | 0.0469 | -0.0376 |
| 500000. | 80.00 | 90.0000 | 0.5440 | 0.5417 | 0.0342 | -0.0363 |
| 500000. | 80.00 | 105.0000 | 0.5538 | 0.5526 | 0.0247 | -0.0279 |
| 500000. | 80.00 | 120.0000 | 0.5597 | 0.5593 | 0.0213 | -0.0155 |
| 500000. | 80.00 | 135.0000 | 0.5610 | 0.5604 | 0.0247 | -0.0041 |
| 500000. | 80.00 | 150.0000 | 0.5578 | 0.5569 | 0.0318 | 0.0013 |
| 500000. | 80.00 | 165.0000 | 0.5525 | 0.5512 | 0.0378 | -0.0001 |
| 500000. | 80.00 | 180.0000 | 0.5470 | 0.5455 | 0.0395 | -0.0062 |
| 500000. | 80.00 | 195.0000 | 0.5429 | 0.5416 | 0.0357 | -0.0139 |
| 500000. | 80.00 | 210.0000 | 0.5412 | 0.5402 | 0.0266 | -0.0193 |
| 500000. | 80.00 | 225.0000 | 0.5415 | 0.5409 | 0.0142 | -0.0190 |
| 500000. | 80.00 | 240.0000 | 0.5419 | 0.5418 | 0.0021 | -0.0112 |
| 500000. | 80.00 | 255.0000 | 0.5406 | 0.5406 | -0.0056 | 0.0030 |
| 500000. | 80.00 | 270.0000 | 0.5366 | 0.5362 | -0.0060 | 0.0199 |
| 500000. | 80.00 | 285.0000 | 0.5301 | 0.5290 | 0.0014 | 0.0348 |
| 500000. | 80.00 | 300.0000 | 0.5224 | 0.5203 | 0.0147 | 0.0445 |
| 500000. | 80.00 | 315.0000 | 0.5148 | 0.5117 | 0.0309 | 0.0470 |
| 500000. | 80.00 | 330.0000 | 0.5089 | 0.5050 | 0.0467 | 0.0422 |
| 500000. | 80.00 | 345.0000 | 0.5059 | 0.5014 | 0.0592 | 0.0319 |
| 500000. | 90.00 | 0. | 0.5329 | 0.5321 | 0 | 0 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 750000. | -90.00 | 0. | 0.5092 | -0.4925 | 0 | 0 |
| 750000. | -80.00 | 0. | 0.4702 | -0.4470 | 0.1280 | 0.0702 |
| 750000. | -80.00 | 15.0000 | 0.4768 | -0.4558 | 0.1077 | 0.0894 |
| 750000. | -80.00 | 30.0000 | 0.4839 | -0.4656 | 0.0836 | 0.1018 |
| 750000. | -80.00 | 45.0000 | 0.4905 | -0.4748 | 0.0583 | 0.1083 |
| 750000. | -80.00 | 60.0000 | 0.4970 | -0.4834 | 0.0328 | 0.1111 |
| 750000. | -80.00 | 75.0000 | 0.5054 | -0.4931 | 0.0062 | 0.1106 |
| 750000. | -80.00 | 90.0000 | 0.5163 | -0.5052 | -0.0211 | 0.1043 |
| 750000. | -80.00 | 105.0000 | 0.5293 | -0.5194 | -0.0458 | 0.0908 |
| 750000. | -80.00 | 120.0000 | 0.5439 | -0.5352 | -0.0655 | 0.0710 |
| 750000. | -80.00 | 135.0000 | 0.5600 | -0.5524 | -0.0803 | 0.0454 |
| 750000. | -80.00 | 150.0000 | 0.5755 | -0.5682 | -0.0903 | 0.0121 |
| 750000. | -80.00 | 165.0000 | 0.5852 | -0.5770 | -0.0926 | -0.0300 |
| 750000. | -80.00 | 180.0000 | 0.5836 | -0.5727 | -0.0823 | -0.0760 |
| 750000. | -80.00 | 195.0000 | 0.5690 | -0.5541 | -0.0579 | -0.1155 |
| 750000. | -80.00 | 210.0000 | 0.5451 | -0.5263 | -0.0232 | -0.1399 |
| 750000. | -80.00 | 225.0000 | 0.5186 | -0.4972 | 0.0154 | -0.1466 |
| 750000. | -80.00 | 240.0000 | 0.4955 | -0.4727 | 0.0528 | -0.1386 |
| 750000. | -80.00 | 255.0000 | 0.4787 | -0.4552 | 0.0859 | -0.1209 |
| 750000. | -80.00 | 270.0000 | 0.4681 | -0.4437 | 0.1133 | -0.0968 |
| 750000. | -80.00 | 285.0000 | 0.4622 | -0.4371 | 0.1338 | -0.0685 |
| 750000. | -80.00 | 300.0000 | 0.4599 | -0.4343 | 0.1462 | -0.0385 |
| 750000. | -80.00 | 315.0000 | 0.4601 | -0.4344 | 0.1511 | -0.0089 |
| 750000. | -80.00 | 330.0000 | 0.4618 | -0.4364 | 0.1498 | 0.0193 |
| 750000. | -80.00 | 345.0000 | 0.4651 | -0.4404 | 0.1422 | 0.0461 |
| 750000. | -70.00 | 0. | 0.4106 | -0.3744 | 0.1547 | 0.0672 |
| 750000. | -70.00 | 15.0000 | 0.4256 | -0.3927 | 0.1388 | 0.0875 |
| 750000. | -70.00 | 30.0000 | 0.4465 | -0.4187 | 0.1189 | 0.0995 |
| 750000. | -70.00 | 45.0000 | 0.4628 | -0.4413 | 0.0963 | 0.1010 |
| 750000. | -70.00 | 60.0000 | 0.4734 | -0.4559 | 0.0746 | 0.1035 |
| 750000. | -70.00 | 75.0000 | 0.4947 | -0.4791 | 0.0503 | 0.1123 |
| 750000. | -70.00 | 90.0000 | 0.5294 | -0.5173 | 0.0215 | 0.1102 |
| 750000. | -70.00 | 105.0000 | 0.5596 | -0.5527 | -0.0044 | 0.0880 |
| 750000. | -70.00 | 120.0000 | 0.5752 | -0.5721 | -0.0196 | 0.0563 |
| 750000. | -70.00 | 135.0000 | 0.5827 | -0.5815 | -0.0215 | 0.0295 |
| 750000. | -70.00 | 150.0000 | 0.5971 | -0.5968 | -0.0168 | 0.0089 |
| 750000. | -70.00 | 165.0000 | 0.6192 | -0.6187 | -0.0106 | -0.0233 |
| 750000. | -70.00 | 180.0000 | 0.6266 | -0.6227 | 0.0042 | -0.0697 |
| 750000. | -70.00 | 195.0000 | 0.6100 | -0.6001 | 0.0263 | -0.1065 |
| 750000. | -70.00 | 210.0000 | 0.5795 | -0.5658 | 0.0460 | -0.1257 |
| 750000. | -70.00 | 225.0000 | 0.5421 | -0.5216 | 0.0636 | -0.1331 |
| 750000. | -70.00 | 240.0000 | 0.5037 | -0.4791 | 0.0841 | -0.1306 |
| 750000. | -70.00 | 255.0000 | 0.4701 | -0.4411 | 0.1095 | -0.1203 |
| 750000. | -70.00 | 270.0000 | 0.4421 | -0.4079 | 0.1375 | -0.1010 |
| 750000. | -70.00 | 285.0000 | 0.4228 | -0.3844 | 0.1616 | -0.0699 |
| 750000. | -70.00 | 300.0000 | 0.4162 | -0.3758 | 0.1754 | -0.0354 |
| 750000. | -70.00 | 315.0000 | 0.4143 | -0.3733 | 0.1795 | -0.0076 |
| 750000. | -70.00 | 330.0000 | 0.4093 | -0.3687 | 0.1769 | 0.0168 |
| 750000. | -70.00 | 345.0000 | 0.4058 | -0.3668 | 0.1681 | 0.0426 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | $B_z$ (oersteds) | $B_y$ (oersteds) | $B_x$ (oersteds) |
|---|---|---|---|---|---|---|
| 750000. | -60.00 | 0. | 0.3489 | -0.3100 | 0.1463 | 0.0652 |
| 750000. | -60.00 | 15.0000 | 0.3607 | -0.3261 | 0.1348 | 0.0748 |
| 750000. | -60.00 | 30.0000 | 0.3818 | -0.3490 | 0.1280 | 0.0872 |
| 750000. | -60.00 | 45.0000 | 0.4125 | -0.3834 | 0.1183 | 0.0958 |
| 750000. | -60.00 | 60.0000 | 0.4390 | -0.4157 | 0.1007 | 0.0988 |
| 750000. | -60.00 | 75.0000 | 0.4693 | -0.4501 | 0.0829 | 0.1038 |
| 750000. | -60.00 | 90.0000 | 0.5082 | -0.4931 | 0.0711 | 0.1004 |
| 750000. | -60.00 | 105.0000 | 0.5487 | -0.5389 | 0.0590 | 0.0844 |
| 750000. | -60.00 | 120.0000 | 0.5807 | -0.5763 | 0.0482 | 0.0521 |
| 750000. | -60.00 | 135.0000 | 0.5979 | -0.5959 | 0.0451 | 0.0184 |
| 750000. | -60.00 | 150.0000 | 0.6101 | -0.6075 | 0.0561 | -0.0077 |
| 750000. | -60.00 | 165.0000 | 0.6283 | -0.6225 | 0.0764 | -0.0376 |
| 750000. | -60.00 | 180.0000 | 0.6178 | -0.6039 | 0.1000 | -0.0834 |
| 750000. | -60.00 | 195.0000 | 0.5766 | -0.5538 | 0.1220 | -0.1044 |
| 750000. | -60.00 | 210.0000 | 0.5399 | -0.5110 | 0.1391 | -0.1052 |
| 750000. | -60.00 | 225.0000 | 0.5134 | -0.4817 | 0.1464 | -0.1007 |
| 750000. | -60.00 | 240.0000 | 0.4898 | -0.4554 | 0.1471 | -0.1043 |
| 750000. | -60.00 | 255.0000 | 0.4571 | -0.4157 | 0.1561 | -0.1087 |
| 750000. | -60.00 | 270.0000 | 0.4187 | -0.3688 | 0.1715 | -0.0993 |
| 750000. | -60.00 | 285.0000 | 0.3832 | -0.3251 | 0.1890 | -0.0739 |
| 750000. | -60.00 | 300.0000 | 0.3608 | -0.2971 | 0.2014 | -0.0360 |
| 750000. | -60.00 | 315.0000 | 0.3482 | -0.2855 | 0.1994 | 0.0003 |
| 750000. | -60.00 | 330.0000 | 0.3406 | -0.2856 | 0.1832 | 0.0292 |
| 750000. | -60.00 | 345.0000 | 0.3404 | -0.2941 | 0.1636 | 0.0510 |
| 750000. | -50.00 | 0. | 0.3038 | -0.2649 | 0.1337 | 0.0654 |
| 750000. | -50.00 | 15.0000 | 0.3212 | -0.2886 | 0.1234 | 0.0681 |
| 750000. | -50.00 | 30.0000 | 0.3421 | -0.3123 | 0.1206 | 0.0703 |
| 750000. | -50.00 | 45.0000 | 0.3667 | -0.3366 | 0.1214 | 0.0802 |
| 750000. | -50.00 | 60.0000 | 0.4014 | -0.3728 | 0.1179 | 0.0907 |
| 750000. | -50.00 | 75.0000 | 0.4439 | -0.4202 | 0.1062 | 0.0962 |
| 750000. | -50.00 | 90.0000 | 0.4852 | -0.4678 | 0.0938 | 0.0886 |
| 750000. | -50.00 | 105.0000 | 0.5322 | -0.5195 | 0.0900 | 0.0729 |
| 750000. | -50.00 | 120.0000 | 0.5670 | -0.5576 | 0.0962 | 0.0372 |
| 750000. | -50.00 | 135.0000 | 0.5853 | -0.5749 | 0.1097 | 0.0035 |
| 750000. | -50.00 | 150.0000 | 0.5801 | -0.5639 | 0.1321 | -0.0333 |
| 750000. | -50.00 | 165.0000 | 0.5711 | -0.5476 | 0.1542 | -0.0507 |
| 750000. | -50.00 | 180.0000 | 0.5530 | -0.5216 | 0.1664 | -0.0777 |
| 750000. | -50.00 | 195.0000 | 0.5217 | -0.4852 | 0.1698 | -0.0889 |
| 750000. | -50.00 | 210.0000 | 0.4841 | -0.4436 | 0.1707 | -0.0915 |
| 750000. | -50.00 | 225.0000 | 0.4558 | -0.4117 | 0.1766 | -0.0842 |
| 750000. | -50.00 | 240.0000 | 0.4413 | -0.3907 | 0.1860 | -0.0866 |
| 750000. | -50.00 | 255.0000 | 0.4121 | -0.3518 | 0.1923 | -0.0953 |
| 750000. | -50.00 | 270.0000 | 0.3728 | -0.3016 | 0.1999 | -0.0899 |
| 750000. | -50.00 | 285.0000 | 0.3315 | -0.2493 | 0.2075 | -0.0685 |
| 750000. | -50.00 | 300.0000 | 0.2992 | -0.2155 | 0.2060 | -0.0259 |
| 750000. | -50.00 | 315.0000 | 0.2853 | -0.2107 | 0.1917 | 0.0164 |
| 750000. | -50.00 | 330.0000 | 0.2863 | -0.2252 | 0.1713 | 0.0439 |
| 750000. | -50.00 | 345.0000 | 0.2912 | -0.2425 | 0.1499 | 0.0592 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 750000. | -40.00 | 0. | 0.2775 | -0.2411 | 0.1210 | 0.0649 |
| 750000. | -40.00 | 15.0000 | 0.2969 | -0.2658 | 0.1197 | 0.0565 |
| 750000. | -40.00 | 30.0000 | 0.3104 | -0.2783 | 0.1250 | 0.0573 |
| 750000. | -40.00 | 45.0000 | 0.3362 | -0.3041 | 0.1272 | 0.0663 |
| 750000. | -40.00 | 60.0000 | 0.3735 | -0.3400 | 0.1334 | 0.0783 |
| 750000. | -40.00 | 75.0000 | 0.4261 | -0.3945 | 0.1354 | 0.0870 |
| 750000. | -40.00 | 90.0000 | 0.4785 | -0.4519 | 0.1371 | 0.0771 |
| 750000. | -40.00 | 105.0000 | 0.5203 | -0.4967 | 0.1454 | 0.0534 |
| 750000. | -40.00 | 120.0000 | 0.5488 | -0.5248 | 0.1590 | 0.0205 |
| 750000. | -40.00 | 135.0000 | 0.5586 | -0.5303 | 0.1750 | -0.0107 |
| 750000. | -40.00 | 150.0000 | 0.5441 | -0.5110 | 0.1825 | -0.0398 |
| 750000. | -40.00 | 165.0000 | 0.5291 | -0.4899 | 0.1921 | -0.0555 |
| 750000. | -40.00 | 180.0000 | 0.5050 | -0.4559 | 0.2043 | -0.0741 |
| 750000. | -40.00 | 195.0000 | 0.4694 | -0.4112 | 0.2124 | -0.0787 |
| 750000. | -40.00 | 210.0000 | 0.4450 | -0.3840 | 0.2120 | -0.0748 |
| 750000. | -40.00 | 225.0000 | 0.4214 | -0.3546 | 0.2142 | -0.0769 |
| 750000. | -40.00 | 240.0000 | 0.3961 | -0.3219 | 0.2174 | -0.0778 |
| 750000. | -40.00 | 255.0000 | 0.3665 | -0.2839 | 0.2170 | -0.0817 |
| 750000. | -40.00 | 270.0000 | 0.3277 | -0.2343 | 0.2153 | -0.0783 |
| 750000. | -40.00 | 285.0000 | 0.2841 | -0.1828 | 0.2100 | -0.0566 |
| 750000. | -40.00 | 300.0000 | 0.2521 | -0.1506 | 0.2017 | -0.0132 |
| 750000. | -40.00 | 315.0000 | 0.2438 | -0.1538 | 0.1868 | 0.0295 |
| 750000. | -40.00 | 330.0000 | 0.2490 | -0.1777 | 0.1643 | 0.0587 |
| 750000. | -40.00 | 345.0000 | 0.2622 | -0.2126 | 0.1372 | 0.0567 |
| 750000. | -30.00 | 0. | 0.2746 | -0.2372 | 0.1227 | 0.0640 |
| 750000. | -30.00 | 15.0000 | 0.2822 | -0.2498 | 0.1237 | 0.0444 |
| 750000. | -30.00 | 30.0000 | 0.2972 | -0.2629 | 0.1294 | 0.0497 |
| 750000. | -30.00 | 45.0000 | 0.3242 | -0.2872 | 0.1427 | 0.0478 |
| 750000. | -30.00 | 60.0000 | 0.3531 | -0.3098 | 0.1577 | 0.0622 |
| 750000. | -30.00 | 75.0000 | 0.4019 | -0.3557 | 0.1730 | 0.0708 |
| 750000. | -30.00 | 90.0000 | 0.4515 | -0.4073 | 0.1854 | 0.0602 |
| 750000. | -30.00 | 105.0000 | 0.4914 | -0.4464 | 0.2021 | 0.0370 |
| 750000. | -30.00 | 120.0000 | 0.5122 | -0.4603 | 0.2248 | 0.0021 |
| 750000. | -30.00 | 135.0000 | 0.5100 | -0.4486 | 0.2418 | -0.0190 |
| 750000. | -30.00 | 150.0000 | 0.5023 | -0.4346 | 0.2488 | -0.0393 |
| 750000. | -30.00 | 165.0000 | 0.4824 | -0.4050 | 0.2558 | -0.0570 |
| 750000. | -30.00 | 180.0000 | 0.4535 | -0.3678 | 0.2567 | -0.0671 |
| 750000. | -30.00 | 195.0000 | 0.4228 | -0.3340 | 0.2499 | -0.0686 |
| 750000. | -30.00 | 210.0000 | 0.4005 | -0.3029 | 0.2528 | -0.0688 |
| 750000. | -30.00 | 225.0000 | 0.3738 | -0.2691 | 0.2505 | -0.0673 |
| 750000. | -30.00 | 240.0000 | 0.3488 | -0.2407 | 0.2437 | -0.0662 |
| 750000. | -30.00 | 255.0000 | 0.3236 | -0.2092 | 0.2370 | -0.0689 |
| 750000. | -30.00 | 270.0000 | 0.2910 | -0.1655 | 0.2304 | -0.0649 |
| 750000. | -30.00 | 285.0000 | 0.2576 | -0.1228 | 0.2224 | -0.0430 |
| 750000. | -30.00 | 300.0000 | 0.2310 | -0.0995 | 0.2085 | -0.0005 |
| 750000. | -30.00 | 315.0000 | 0.2230 | -0.1114 | 0.1885 | 0.0422 |
| 750000. | -30.00 | 330.0000 | 0.2325 | -0.1479 | 0.1643 | 0.0721 |
| 750000. | -30.00 | 345.0000 | 0.2558 | -0.1986 | 0.1410 | 0.0782 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 750000. | -20.00 | 0. | 0.2852 | -0.2287 | 0.1571 | 0.0660 |
| 750000. | -20.00 | 15.0000 | 0.2922 | -0.2465 | 0.1519 | 0.0388 |
| 750000. | -20.00 | 30.0000 | 0.3017 | -0.2516 | 0.1629 | 0.0343 |
| 750000. | -20.00 | 45.0000 | 0.3188 | -0.2592 | 0.1827 | 0.0328 |
| 750000. | -20.00 | 60.0000 | 0.3430 | -0.2756 | 0.1993 | 0.0448 |
| 750000. | -20.00 | 75.0000 | 0.3778 | -0.3035 | 0.2185 | 0.0535 |
| 750000. | -20.00 | 90.0000 | 0.4224 | -0.3469 | 0.2371 | 0.0429 |
| 750000. | -20.00 | 105.0000 | 0.4509 | -0.3663 | 0.2625 | 0.0160 |
| 750000. | -20.00 | 120.0000 | 0.4574 | -0.3592 | 0.2829 | -0.0095 |
| 750000. | -20.00 | 135.0000 | 0.4504 | -0.3442 | 0.2896 | -0.0236 |
| 750000. | -20.00 | 150.0000 | 0.4396 | -0.3260 | 0.2924 | -0.0388 |
| 750000. | -20.00 | 165.0000 | 0.4181 | -0.2970 | 0.2897 | -0.0518 |
| 750000. | -20.00 | 180.0000 | 0.3949 | -0.2632 | 0.2879 | -0.0614 |
| 750000. | -20.00 | 195.0000 | 0.3757 | -0.2331 | 0.2882 | -0.0613 |
| 750000. | -20.00 | 210.0000 | 0.3497 | -0.2006 | 0.2801 | -0.0597 |
| 750000. | -20.00 | 225.0000 | 0.3288 | -0.1755 | 0.2719 | -0.0581 |
| 750000. | -20.00 | 240.0000 | 0.3121 | -0.1538 | 0.2659 | -0.0554 |
| 750000. | -20.00 | 255.0000 | 0.2938 | -0.1274 | 0.2582 | -0.0586 |
| 750000. | -20.00 | 270.0000 | 0.2709 | -0.0917 | 0.2492 | -0.0533 |
| 750000. | -20.00 | 285.0000 | 0.2477 | -0.0563 | 0.2391 | -0.0319 |
| 750000. | -20.00 | 300.0000 | 0.2292 | -0.0426 | 0.2249 | 0.0114 |
| 750000. | -20.00 | 315.0000 | 0.2241 | -0.0639 | 0.2079 | 0.0540 |
| 750000. | -20.00 | 330.0000 | 0.2341 | -0.1111 | 0.1894 | 0.0811 |
| 750000. | -20.00 | 345.0000 | 0.2584 | -0.1747 | 0.1691 | 0.0877 |
| 750000. | -10.00 | 0. | 0.2835 | -0.1836 | 0.2067 | 0.0630 |
| 750000. | -10.00 | 15.0000 | 0.2990 | -0.2082 | 0.2116 | 0.0361 |
| 750000. | -10.00 | 30.0000 | 0.3048 | -0.2089 | 0.2209 | 0.0212 |
| 750000. | -10.00 | 45.0000 | 0.3131 | -0.2018 | 0.2387 | 0.0185 |
| 750000. | -10.00 | 60.0000 | 0.3323 | -0.2093 | 0.2561 | 0.0317 |
| 750000. | -10.00 | 75.0000 | 0.3579 | -0.2297 | 0.2718 | 0.0385 |
| 750000. | -10.00 | 90.0000 | 0.3902 | -0.2599 | 0.2898 | 0.0279 |
| 750000. | -10.00 | 105.0000 | 0.4021 | -0.2608 | 0.3060 | -0.0002 |
| 750000. | -10.00 | 120.0000 | 0.4004 | -0.2387 | 0.3209 | -0.0179 |
| 750000. | -10.00 | 135.0000 | 0.3937 | -0.2189 | 0.3265 | -0.0233 |
| 750000. | -10.00 | 150.0000 | 0.3819 | -0.2030 | 0.3217 | -0.0344 |
| 750000. | -10.00 | 165.0000 | 0.3671 | -0.1787 | 0.3170 | -0.0479 |
| 750000. | -10.00 | 180.0000 | 0.3489 | -0.1468 | 0.3116 | -0.0552 |
| 750000. | -10.00 | 195.0000 | 0.3279 | -0.1181 | 0.3011 | -0.0535 |
| 750000. | -10.00 | 210.0000 | 0.3126 | -0.0955 | 0.2931 | -0.0518 |
| 750000. | -10.00 | 225.0000 | 0.2989 | -0.0771 | 0.2846 | -0.0493 |
| 750000. | -10.00 | 240.0000 | 0.2875 | -0.0598 | 0.2769 | -0.0490 |
| 750000. | -10.00 | 255.0000 | 0.2803 | -0.0393 | 0.2728 | -0.0509 |
| 750000. | -10.00 | 270.0000 | 0.2725 | -0.0074 | 0.2683 | -0.0466 |
| 750000. | -10.00 | 285.0000 | 0.2627 | 0.0248 | 0.2605 | -0.0232 |
| 750000. | -10.00 | 300.0000 | 0.2516 | 0.0332 | 0.2485 | 0.0218 |
| 750000. | -10.00 | 315.0000 | 0.2399 | 0.0016 | 0.2314 | 0.0631 |
| 750000. | -10.00 | 330.0000 | 0.2391 | -0.0560 | 0.2145 | 0.0894 |
| 750000. | -10.00 | 345.0000 | 0.2598 | -0.1295 | 0.2058 | 0.0916 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 750000. | 0.00 | 0. | 0.2782 | -0.1080 | 0.2502 | 0.0562 |
| 750000. | 0.00 | 15.0000 | 0.2937 | -0.1221 | 0.2655 | 0.0287 |
| 750000. | 0.00 | 30.0000 | 0.3025 | -0.1201 | 0.2773 | 0.0121 |
| 750000. | 0.00 | 45.0000 | 0.3073 | -0.1059 | 0.2883 | 0.0081 |
| 750000. | 0.00 | 60.0000 | 0.3220 | -0.1030 | 0.3045 | 0.0197 |
| 750000. | 0.00 | 75.0000 | 0.3418 | -0.1181 | 0.3196 | 0.0273 |
| 750000. | 0.00 | 90.0000 | 0.3634 | -0.1389 | 0.3353 | 0.0172 |
| 750000. | 0.00 | 105.0000 | 0.3713 | -0.1331 | 0.3465 | -0.0073 |
| 750000. | 0.00 | 120.0000 | 0.3605 | -0.1068 | 0.3438 | -0.0190 |
| 750000. | 0.00 | 135.0000 | 0.3466 | -0.0888 | 0.3345 | -0.0195 |
| 750000. | 0.00 | 150.0000 | 0.3353 | -0.0765 | 0.3252 | -0.0280 |
| 750000. | 0.00 | 165.0000 | 0.3219 | -0.0558 | 0.3140 | -0.0438 |
| 750000. | 0.00 | 180.0000 | 0.3100 | -0.0259 | 0.3051 | -0.0482 |
| 750000. | 0.00 | 195.0000 | 0.3051 | -0.0027 | 0.3013 | -0.0481 |
| 750000. | 0.00 | 210.0000 | 0.2976 | 0.0125 | 0.2938 | -0.0457 |
| 750000. | 0.00 | 225.0000 | 0.2934 | 0.0247 | 0.2890 | -0.0439 |
| 750000. | 0.00 | 240.0000 | 0.2946 | 0.0352 | 0.2883 | -0.0467 |
| 750000. | 0.00 | 255.0000 | 0.2961 | 0.0606 | 0.2859 | -0.0475 |
| 750000. | 0.00 | 270.0000 | 0.2984 | 0.0923 | 0.2805 | -0.0425 |
| 750000. | 0.00 | 285.0000 | 0.2999 | 0.1231 | 0.2730 | -0.0149 |
| 750000. | 0.00 | 300.0000 | 0.2882 | 0.1238 | 0.2585 | 0.0303 |
| 750000. | 0.00 | 315.0000 | 0.2730 | 0.0847 | 0.2497 | 0.0706 |
| 750000. | 0.00 | 330.0000 | 0.2620 | 0.0187 | 0.2432 | 0.0954 |
| 750000. | 0.00 | 345.0000 | 0.2628 | -0.0588 | 0.2400 | 0.0894 |
| 750000. | 10.00 | 0. | 0.2871 | -0.0[illegible] | 0.2834 | 0.0454 |
| 750000. | 10.00 | 15.0000 | 0.2968 | -0.[illegible] | 0.2960 | 0.0210 |
| 750000. | 10.00 | 30.0000 | 0.3065 | 0.[illegible] | 0.3065 | 0.0051 |
| 750000. | 10.00 | 45.0000 | 0.3154 | 0.0[illegible] | 0.3149 | 0.0015 |
| 750000. | 10.00 | 60.0000 | 0.3286 | 0.0259 | 0.3275 | 0.0086 |
| 750000. | 10.00 | 75.0000 | 0.3450 | 0.0171 | 0.3441 | 0.0171 |
| 750000. | 10.00 | 90.0000 | 0.3586 | 0.0057 | 0.3585 | 0.0101 |
| 750000. | 10.00 | 105.0000 | 0.3566 | 0.0117 | 0.3563 | -0.0069 |
| 750000. | 10.00 | 120.0000 | 0.3489 | 0.0275 | 0.3477 | -0.0115 |
| 750000. | 10.00 | 135.0000 | 0.3350 | 0.0363 | 0.3328 | -0.0111 |
| 750000. | 10.00 | 150.0000 | 0.3175 | 0.0394 | 0.3144 | -0.0193 |
| 750000. | 10.00 | 165.0000 | 0.3079 | 0.0547 | 0.3009 | -0.0363 |
| 750000. | 10.00 | 180.0000 | 0.3011 | 0.0767 | 0.2880 | -0.0426 |
| 750000. | 10.00 | 195.0000 | 0.2988 | 0.0980 | 0.2785 | -0.0458 |
| 750000. | 10.00 | 210.0000 | 0.3046 | 0.1140 | 0.2789 | -0.0448 |
| 750000. | 10.00 | 225.0000 | 0.3129 | 0.1272 | 0.2823 | -0.0456 |
| 750000. | 10.00 | 240.0000 | 0.3231 | 0.1458 | 0.2845 | -0.0472 |
| 750000. | 10.00 | 255.0000 | 0.3345 | 0.1694 | 0.2847 | -0.0466 |
| 750000. | 10.00 | 270.0000 | 0.3477 | 0.2014 | 0.2808 | -0.0387 |
| 750000. | 10.00 | 285.0000 | 0.3530 | 0.2299 | 0.2678 | -0.0059 |
| 750000. | 10.00 | 300.0000 | 0.3388 | 0.2198 | 0.2550 | 0.0385 |
| 750000. | 10.00 | 315.0000 | 0.3155 | 0.1792 | 0.2489 | 0.0739 |
| 750000. | 10.00 | 330.0000 | 0.2924 | 0.1115 | 0.2523 | 0.0969 |
| 750000. | 10.00 | 345.0000 | 0.2805 | 0.0318 | 0.2657 | 0.0843 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 750000. | 20.00 | 0. | 0.3143 | 0.1170 | 0.2893 | .0377 |
| 750000. | 20.00 | 15.0000 | 0.3205 | 0.1179 | 0.[illegible] | 0.0169 |
| 750000. | 20.00 | 30.0000 | 0.3321 | 0.1313 | 0.3[illegible] | -0.0015 |
| 750000. | 20.00 | 45.0000 | 0.3457 | 0.1459 | 0.3154 | -0.0057 |
| 750000. | 20.00 | 60.0000 | 0.3623 | 0.1605 | 0.3248 | -0.0002 |
| 750000. | 20.00 | 75.0000 | 0.3770 | 0.1631 | 0.3398 | 0.0057 |
| 750000. | 20.00 | 90.0000 | 0.3854 | 0.1604 | 0.3504 | 0.0059 |
| 750000. | 20.00 | 105.0000 | 0.3848 | 0.1575 | 0.3511 | -0.0016 |
| 750000. | 20.00 | 120.0000 | 0.3753 | 0.1644 | 0.3373 | -0.0008 |
| 750000. | 20.00 | 135.0000 | 0.3522 | 0.1547 | 0.3164 | 0.0027 |
| 750000. | 20.00 | 150.0000 | 0.3292 | 0.1423 | 0.2968 | -0.0070 |
| 750000. | 20.00 | 165.0000 | 0.3120 | 0.1450 | 0.2750 | -0.0263 |
| 750000. | 20.00 | 180.0000 | 0.3108 | 0.1625 | 0.2621 | -0.0381 |
| 750000. | 20.00 | 195.0000 | 0.3204 | 0.1829 | 0.2589 | -0.0463 |
| 750000. | 20.00 | 210.0000 | 0.3321 | 0.2024 | 0.2586 | -0.0493 |
| 750000. | 20.00 | 225.0000 | 0.3512 | 0.2259 | 0.2640 | -0.0510 |
| 750000. | 20.00 | 240.0000 | 0.3723 | 0.2513 | 0.2698 | -0.0516 |
| 750000. | 20.00 | 255.0000 | 0.3920 | 0.2797 | 0.2704 | -0.0478 |
| 750000. | 20.00 | 270.0000 | 0.4079 | 0.3124 | 0.2604 | -0.0318 |
| 750000. | 20.00 | 285.0000 | 0.4099 | 0.3292 | 0.2442 | 0.0051 |
| 750000. | 20.00 | 300.0000 | 0.3906 | 0.3099 | 0.2332 | 0.0457 |
| 750000. | 20.00 | 315.0000 | 0.3599 | 0.2634 | 0.2332 | 0.0759 |
| 750000. | 20.00 | 330.0000 | 0.3308 | 0.2017 | 0.2456 | 0.0918 |
| 750000. | 20.00 | 345.0000 | 0.3144 | 0.1414 | 0.2715 | 0.0716 |
| 750000. | 30.00 | 0. | 0.3559 | 0.2354 | 0.2652 | 0.0309 |
| 750000. | 30.00 | 15.0000 | 0.3606 | 0.2346 | 0.2735 | 0.0146 |
| 750000. | 30.00 | 30.0000 | 0.3713 | 0.2470 | 0.2772 | -0.0060 |
| 750000. | 30.00 | 45.0000 | 0.3890 | 0.2665 | 0.2830 | -0.0129 |
| 750000. | 30.00 | 60.0000 | 0.4085 | 0.2865 | 0.2911 | -0.0094 |
| 750000. | 30.00 | 75.0000 | 0.4213 | 0.2950 | 0.3007 | -0.0031 |
| 750000. | 30.00 | 90.0000 | 0.4312 | 0.2977 | 0.3120 | 0.0010 |
| 750000. | 30.00 | 105.0000 | 0.4317 | 0.2962 | 0.3140 | 0.0028 |
| 750000. | 30.00 | 120.0000 | 0.4195 | 0.2886 | 0.3043 | 0.0113 |
| 750000. | 30.00 | 135.0000 | 0.3967 | 0.2670 | 0.2928 | 0.0163 |
| 750000. | 30.00 | 150.0000 | 0.3672 | 0.2416 | 0.2764 | 0.0071 |
| 750000. | 30.00 | 165.0000 | 0.3459 | 0.2283 | 0.2595 | -0.0132 |
| 750000. | 30.00 | 180.0000 | 0.3393 | 0.2346 | 0.2427 | -0.0341 |
| 750000. | 30.00 | 195.0000 | 0.3511 | 0.2563 | 0.2350 | -0.0481 |
| 750000. | 30.00 | 210.0000 | 0.3704 | 0.2814 | 0.2345 | -0.0551 |
| 750000. | 30.00 | 225.0000 | 0.3977 | 0.3140 | 0.2366 | -0.0603 |
| 750000. | 30.00 | 240.0000 | 0.4260 | 0.3494 | 0.2370 | -0.0570 |
| 750000. | 30.00 | 255.0000 | 0.4523 | 0.3845 | 0.2333 | -0.0475 |
| 750000. | 30.00 | 270.0000 | 0.4662 | 0.4095 | 0.2217 | -0.0224 |
| 750000. | 30.00 | 285.0000 | 0.4621 | 0.4126 | 0.2077 | 0.0148 |
| 750000. | 30.00 | 300.0000 | 0.4403 | 0.3873 | 0.2027 | 0.0524 |
| 750000. | 30.00 | 315.0000 | 0.4073 | 0.3416 | 0.2083 | 0.0763 |
| 750000. | 30.00 | 330.0000 | 0.3720 | 0.2843 | 0.2262 | 0.0798 |
| 750000. | 30.00 | 345.0000 | 0.3594 | 0.2494 | 0.2514 | 0.0616 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 750000. | 40.00 | 0. | 0.3914 | 0.3219 | 0.2209 | 0.0284 |
| 750000. | 40.00 | 15.0000 | 0.3954 | 0.3237 | 0.2268 | 0.0095 |
| 750000. | 40.00 | 30.0000 | 0.4091 | 0.3378 | 0.2307 | -0.0078 |
| 750000. | 40.00 | 45.0000 | 0.4254 | 0.3563 | 0.2316 | -0.0190 |
| 750000. | 40.00 | 60.0000 | 0.4482 | 0.3798 | 0.2374 | -0.0186 |
| 750000. | 40.00 | 75.0000 | 0.4667 | 0.3952 | 0.2478 | -0.0122 |
| 750000. | 40.00 | 90.0000 | 0.4811 | 0.4073 | 0.2560 | -0.0078 |
| 750000. | 40.00 | 105.0000 | 0.4891 | 0.4125 | 0.2627 | 0.0054 |
| 750000. | 40.00 | 120.0000 | 0.4757 | 0.3977 | 0.2602 | 0.0198 |
| 750000. | 40.00 | 135.0000 | 0.4464 | 0.3669 | 0.2527 | 0.0289 |
| 750000. | 40.00 | 150.0000 | 0.4098 | 0.3285 | 0.2441 | 0.0200 |
| 750000. | 40.00 | 165.0000 | 0.3874 | 0.3077 | 0.2354 | -0.0028 |
| 750000. | 40.00 | 180.0000 | 0.3805 | 0.3051 | 0.2255 | -0.0297 |
| 750000. | 40.00 | 195.0000 | 0.3953 | 0.3275 | 0.2159 | -0.0485 |
| 750000. | 40.00 | 210.0000 | 0.4174 | 0.3560 | 0.2092 | -0.0614 |
| 750000. | 40.00 | 225.0000 | 0.4469 | 0.3924 | 0.2034 | -0.0655 |
| 750000. | 40.00 | 240.0000 | 0.4764 | 0.4302 | 0.1956 | -0.0605 |
| 750000. | 40.00 | 255.0000 | 0.5036 | 0.4667 | 0.1839 | -0.0442 |
| 750000. | 40.00 | 270.0000 | 0.5137 | 0.4851 | 0.1685 | -0.0129 |
| 750000. | 40.00 | 285.0000 | 0.5046 | 0.4784 | 0.1589 | 0.0234 |
| 750000. | 40.00 | 300.0000 | 0.4770 | 0.4462 | 0.1583 | 0.0578 |
| 750000. | 40.00 | 315.0000 | 0.4463 | 0.4054 | 0.1722 | 0.0718 |
| 750000. | 40.00 | 330.0000 | 0.4188 | 0.3644 | 0.1949 | 0.0678 |
| 750000. | 40.00 | 345.0000 | 0.4055 | 0.3411 | 0.2114 | 0.0579 |
| 750000. | 50.00 | 0. | 0.4238 | 0.3844 | 0.1764 | 0.0264 |
| 750000. | 50.00 | 15.0000 | 0.4291 | 0.3881 | 0.1829 | 0.0067 |
| 750000. | 50.00 | 30.0000 | 0.4386 | 0.3987 | 0.1826 | -0.0100 |
| 750000. | 50.00 | 45.0000 | 0.4561 | 0.4173 | 0.1826 | -0.0229 |
| 750000. | 50.00 | 60.0000 | 0.4795 | 0.4431 | 0.1811 | -0.0278 |
| 750000. | 50.00 | 75.0000 | 0.5009 | 0.4653 | 0.1842 | -0.0222 |
| 750000. | 50.00 | 90.0000 | 0.5187 | 0.4823 | 0.1903 | -0.0151 |
| 750000. | 50.00 | 105.0000 | 0 5255 | 0.4897 | 0.1905 | 0.0044 |
| 750000. | 50.00 | 120.0000 | 0.5166 | 0.4772 | 0.1967 | 0.0211 |
| 750000. | 50.00 | 135.0000 | 0.4960 | 0.4493 | 0.2073 | 0.0334 |
| 750000. | 50.00 | 150.0000 | 0.4661 | 0.[illegible]28 | 0.2148 | 0.0255 |
| 750000. | 50.00 | 165.0000 | 0.4461 | 0.[illegible]17 | 0.2135 | 0.0049 |
| 750000. | 50.00 | 180.0000 | 0.4321 | 0.3814 | 0.2019 | -0.0215 |
| 750000. | 50.00 | 195.0000 | 0.4387 | 0.3945 | 0.1865 | -0.0457 |
| 750000. | 50.00 | 210.0000 | 0.4587 | 0.4204 | 0.1724 | -0.0635 |
| 750000. | 50.00 | 225.0000 | 0.4896 | 0.4584 | 0.1584 | -0.0668 |
| 750000. | 50.00 | 240.0000 | 0.5165 | 0.4932 | 0.1422 | -0.0581 |
| 750000. | 50.00 | 255.0000 | 0.5332 | 0.5179 | 0.1223 | -0.0332 |
| 750000. | 50.00 | 270.0000 | 0.5322 | 0.5215 | 0.1059 | -0.0023 |
| 750000. | 50.00 | 285.0000 | 0.5230 | 0.5122 | 0.1019 | 0.0278 |
| 750000. | 50.00 | 300.0000 | 0.5026 | 0.4861 | 0.1145 | 0.0566 |
| 750000. | 50.00 | 315.0000 | 0.4744 | 0.4515 | 0.1270 | 0.0674 |
| 750000. | 50.00 | 330.0000 | 0.4472 | 0.4183 | 0.1444 | 0.0648 |
| 750000. | 50.00 | 345.0000 | 0.4291 | 0.3947 | 0.1609 | 0.0501 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 750000. | 60.00 | 0. | 0.4496 | 0.4286 | 0.1338 | 0.0234 |
| 750000. | 60.00 | 15.0000 | 0.4533 | 0.4318 | 0.1375 | 0.0058 |
| 750000. | 60.00 | 30.0000 | 0.4605 | 0.4396 | 0.1368 | -0.0101 |
| 750000. | 60.00 | 45.0000 | 0.4728 | 0.4540 | 0.1300 | -0.0230 |
| 750000. | 60.00 | 60.0000 | 0.4888 | 0.4718 | 0.1236 | -0.0320 |
| 750000. | 60.00 | 75.0000 | 0.5159 | 0.4997 | 0.1229 | -0.0364 |
| 750000. | 60.00 | 90.0000 | 0.5430 | 0.5279 | 0.1251 | -0.0227 |
| 750000. | 60.00 | 105.0000 | 0.5490 | 0.5328 | 0.1323 | -0.0015 |
| 750000. | 60.00 | 120.0000 | 0.5488 | 0.5300 | 0.1419 | 0.0134 |
| 750000. | 60.00 | 135.0000 | 0.5350 | 0.5127 | 0.1498 | 0.0303 |
| 750000. | 60.00 | 150.0000 | 0.5081 | 0.4826 | 0.1568 | 0.0257 |
| 750000. | 60.00 | 165.0000 | 0.4910 | 0.4638 | 0.1609 | 0.0091 |
| 750000. | 60.00 | 180.0000 | 0.4787 | 0.4505 | 0.1611 | -0.0137 |
| 750000. | 60.00 | 195.0000 | 0.4813 | 0.4553 | 0.1509 | -0.0397 |
| 750000. | 60.00 | 210.0000 | 0.4960 | 0.4745 | 0.1330 | -0.0567 |
| 750000. | 60.00 | 225.0000 | 0.5169 | 0.5017 | 0.1092 | -0.0599 |
| 750000. | 60.00 | 240.0000 | 0.5347 | 0.5255 | 0.0864 | -0.0475 |
| 750000. | 60.00 | 255.0000 | 0.5436 | 0.5386 | 0.0701 | -0.0215 |
| 750000. | 60.00 | 270.0000 | 0.5345 | 0.5308 | 0.0619 | 0.0101 |
| 750000. | 60.00 | 285.0000 | 0.5187 | 0.5142 | 0.0605 | 0.0301 |
| 750000. | 60.00 | 300.0000 | 0.5091 | 0.5019 | 0.0689 | 0.0503 |
| 750000. | 60.00 | 315.0000 | 0.4873 | 0.4751 | 0.0868 | 0.0651 |
| 750000. | 60.00 | 330.0000 | 0.4634 | 0.4470 | 0.1068 | 0.0589 |
| 750000. | 60.00 | 345.0000 | 0.4524 | 0.4330 | 0.1238 | 0.0424 |
| | | | | | | |
| 750000. | 70.00 | 0. | 0.4704 | 0.4597 | 0.0973 | 0.0216 |
| 750000. | 70.00 | 15.0000 | 0.4728 | 0.4619 | 0.1006 | 0.0064 |
| 750000. | 70.00 | 30.0000 | 0.4765 | 0.4660 | 0.0993 | -0.0067 |
| 750000. | 70.00 | 45.0000 | 0.4813 | 0.4714 | 0.0952 | -0.0199 |
| 750000. | 70.00 | 60.0000 | 0.4730 | 0.4838 | 0.0882 | -0.0343 |
| 750000. | 70.00 | 75.0000 | 0.5150 | 0.5074 | 0.0773 | -0.0417 |
| 750000. | 70.00 | 90.0000 | 0.5386 | 0.5332 | 0.068[illegible] | -0.0343 |
| 750000. | 70.00 | 105.0000 | 0.5558 | 0.5514 | 0.0675 | -0.0179 |
| 750000. | 70.00 | 120.0000 | 0.5632 | 0.5585 | 0.0729 | 0.0029 |
| 750000. | 70.00 | 135.0000 | 0.5540 | 0.5469 | 0.0858 | 0.0211 |
| 750000. | 70.00 | 150.0000 | 0.5349 | 0.5249 | 0.1009 | 0.0208 |
| 750000. | 70.00 | 165.0000 | 0.5217 | 0.5102 | 0.1085 | 0.0063 |
| 750000. | 70.00 | 180.0000 | 0.5155 | 0.5041 | 0.1072 | -0.0113 |
| 750000. | 70.00 | 195.0000 | 0.5144 | 0.5044 | 0.0968 | -0.0285 |
| 750000. | 70.00 | 210.0000 | 0.5187 | 0.5111 | 0.0788 | -0.0402 |
| 750000. | 70.00 | 225.0000 | 0.5261 | 0.5212 | 0.0581 | -0.0420 |
| 750000. | 70.00 | 240.0000 | 0.5346 | 0.5321 | 0.0394 | -0.0333 |
| 750000. | 70.00 | 255.0000 | 0.5410 | 0.5402 | 0.0265 | -0.0130 |
| 750000. | 70.00 | 270.0000 | 0.5377 | 0.5370 | 0.0238 | 0.0142 |
| 750000. | 70.00 | 285.0000 | 0.5248 | 0.5228 | 0.0291 | 0.0356 |
| 750000. | 70.00 | 300.0000 | 0.5097 | 0.5058 | 0.0387 | 0.0498 |
| 750000. | 70.00 | 315.0000 | 0.4931 | 0.4868 | 0.0547 | 0.0566 |
| 750000. | 70.00 | 330.0000 | 0.4788 | 0.4704 | 0.0734 | 0.0507 |
| 750000. | 70.00 | 345.0000 | 0.4717 | 0.4619 | 0.0881 | 0.0371 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 750000. | 80.00 | 0. | 0.4914 | 0.4867 | 0.0644 | 0.0196 |
| 750000. | 80.00 | 15.0000 | 0.4924 | 0.4875 | 0.0684 | 0.0071 |
| 750000. | 80.00 | 30.0000 | 0.4949 | 0.4901 | 0.0687 | -0.0060 |
| 750000. | 80.00 | 45.0000 | 0.4996 | 0.4950 | 0.0649 | -0.0187 |
| 750000. | 80.00 | 60.0000 | 0.5070 | 0.5030 | 0.0569 | -0.0290 |
| 750000. | 80.00 | 75.0000 | 0.5165 | 0.5133 | 0.0457 | -0.0343 |
| 750000. | 80.00 | 90.0000 | 0.5264 | 0.5243 | 0.0342 | -0.0327 |
| 750000. | 80.00 | 105.0000 | 0.5348 | 0.5336 | 0.0259 | -0.0252 |
| 750000. | 80.00 | 120.0000 | 0.5400 | 0.5394 | 0.0231 | -0.0143 |
| 750000. | 80.00 | 135.0000 | 0.5411 | 0.5404 | 0.0262 | -0.0047 |
| 750000. | 80.00 | 150.0000 | 0.5386 | 0.5376 | 0.0324 | -0.0002 |
| 750000. | 80.00 | 165.0000 | 0.5342 | 0.5328 | 0.0376 | -0.0017 |
| 750000. | 80.00 | 180.0000 | 0.5295 | 0.5280 | 0.0387 | -0.0073 |
| 750000. | 80.00 | 195.0000 | 0.5257 | 0.5244 | 0.0347 | -0.0140 |
| 750000. | 80.00 | 210.0000 | 0.5238 | 0.5228 | 0.0260 | -0.0187 |
| 750000. | 80.00 | 225.0000 | 0.5237 | 0.5232 | 0.0144 | -0.0185 |
| 750000. | 80.00 | 240.0000 | 0.5243 | 0.5242 | 0.0030 | -0.0115 |
| 750000. | 80.00 | 255.0000 | 0.5237 | 0.5237 | -0.0045 | 0.0019 |
| 750000. | 80.00 | 270.0000 | 0.5203 | 0.5200 | -0.0050 | 0.0183 |
| 750000. | 80.00 | 285.0000 | 0.5140 | 0.5129 | 0.0021 | 0.0330 |
| 750000. | 80.00 | 300.0000 | 0.5062 | 0.5042 | 0.0148 | 0.0421 |
| 750000. | 80.00 | 315.0000 | 0.4991 | 0.4963 | 0.0301 | 0.0441 |
| 750000. | 80.00 | 330.0000 | 0.4942 | 0.4906 | 0.0447 | 0.0397 |
| 750000. | 80.00 | 345.0000 | 0.4918 | 0.4876 | 0.0564 | 0.0309 |
| 750000. | 90.00 | 0. | 0.5163 | 0.5156 | 0 | 0 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 1000000. | -90.00 | 0. | 0.4927 | -0.4769 | 0 | 0 |
| 1000000. | -80.00 | 0. | 0.4541 | -0.4318 | 0.1231 | 0.0675 |
| 1000000. | -80.00 | 15.0000 | 0.4604 | -0.4403 | 0.1037 | 0.0860 |
| 1000000. | -80.00 | 30.0000 | 0.4674 | -0.4498 | 0.0806 | 0.0983 |
| 1000000. | -80.00 | 45.0000 | 0.4742 | -0.4591 | 0.0563 | 0.1048 |
| 1000000. | -80.00 | 60.0000 | 0.4813 | -0.4680 | 0.0315 | 0.1075 |
| 1000000. | -80.00 | 75.0000 | 0.4899 | -0.4782 | 0.0057 | 0.1065 |
| 1000000. | -80.00 | 90.0000 | 0.5007 | -0.4902 | -0.0205 | 0.0998 |
| 1000000. | -80.00 | 105.0000 | 0.5131 | -0.5039 | -0.0441 | 0.0861 |
| 1000000. | -80.00 | 120.0000 | 0.5266 | -0.5186 | -0.0629 | 0.0662 |
| 1000000. | -80.00 | 135.0000 | 0.5408 | -0.5338 | -0.0767 | 0.0409 |
| 1000000. | -80.00 | 150.0000 | 0.5540 | -0.5473 | -0.0853 | 0.0088 |
| 1000000. | -80.00 | 165.0000 | 0.5620 | -0.5545 | -0.0864 | -0.0303 |
| 1000000. | -80.00 | 180.0000 | 0.5603 | -0.5504 | -0.0759 | -0.0723 |
| 1000000. | -80.00 | 195.0000 | 0.5475 | -0.5340 | -0.0528 | -0.1084 |
| 1000000. | -80.00 | 210.0000 | 0.5265 | -0.5094 | -0.0204 | -0.1312 |
| 1000000. | -80.00 | 225.0000 | 0.5028 | -0.4831 | 0.0158 | -0.1383 |
| 1000000. | -80.00 | 240.0000 | 0.4816 | -0.4603 | 0.0512 | -0.1319 |
| 1000000. | -80.00 | 255.0000 | 0.4656 | -0.4432 | 0.0829 | -0.1159 |
| 1000000. | -80.00 | 270.0000 | 0.4548 | -0.4315 | 0.1093 | -0.0934 |
| 1000000. | -80.00 | 285.0000 | 0.4485 | -0.4243 | 0.1290 | -0.0665 |
| 1000000. | -80.00 | 300.0000 | 0.4455 | -0.4210 | 0.1410 | -0.0377 |
| 1000000. | -80.00 | 315.0000 | 0.4451 | -0.4205 | 0.1458 | -0.0091 |
| 1000000. | -80.00 | 330.0000 | 0.4464 | -0.4220 | 0.1444 | 0.0184 |
| 1000000. | -80.00 | 345.0000 | 0.4493 | -0.4257 | 0.1369 | 0.0443 |
| 1000000. | -70.00 | 0. | 0.3978 | -0.3636 | 0.1479 | 0.0648 |
| 1000000. | -70.00 | 15.0000 | 0.4117 | -0.3807 | 0.1324 | 0.0836 |
| 1000000. | -70.00 | 30.0000 | 0.4308 | -0.4046 | 0.1135 | 0.0951 |
| 1000000. | -70.00 | 45.0000 | 0.4468 | -0.4262 | 0.0921 | 0.0976 |
| 1000000. | -70.00 | 60.0000 | 0.4587 | -0.4419 | 0.0712 | 0.1002 |
| 1000000. | -70.00 | 75.0000 | 0.4793 | -0.4647 | 0.0480 | 0.1071 |
| 1000000. | -70.00 | 90.0000 | 0.5109 | -0.4998 | 0.0212 | 0.1040 |
| 1000000. | -70.00 | 105.0000 | 0.5390 | -0.5325 | -0.0028 | 0.0835 |
| 1000000. | -70.00 | 120.0000 | 0.5549 | -0.5520 | -0.0171 | 0.0540 |
| 1000000. | -70.00 | 135.0000 | 0.5634 | -0.5624 | -0.0196 | 0.0279 |
| 1000000. | -70.00 | 150.0000 | 0.5770 | -0.5767 | -0.0158 | 0.0063 |
| 1000000. | -70.00 | 165.0000 | 0.5955 | -0.5949 | -0.0095 | -0.0250 |
| 1000000. | -70.00 | 180.0000 | 0.6007 | -0.5969 | 0.0049 | -0.0675 |
| 1000000. | -70.00 | 195.0000 | 0.5849 | -0.5754 | 0.0262 | -0.1014 |
| 1000000. | -70.00 | 210.0000 | 0.5564 | -0.5415 | 0.0459 | -0.1194 |
| 1000000. | -70.00 | 225.0000 | 0.5219 | -0.5024 | 0.0637 | -0.1262 |
| 1000000. | -70.00 | 240.0000 | 0.4865 | -0.4629 | 0.0836 | -0.1241 |
| 1000000. | -70.00 | 255.0000 | 0.4551 | -0.4271 | 0.1076 | -0.1145 |
| 1000000. | -70.00 | 270.0000 | 0.4286 | -0.3957 | 0.1336 | -0.0962 |
| 1000000. | -70.00 | 285.0000 | 0.4101 | -0.3732 | 0.1561 | -0.0671 |
| 1000000. | -70.00 | 300.0000 | 0.4027 | -0.3638 | 0.1691 | -0.0345 |
| 1000000. | -70.00 | 315.0000 | 0.3999 | -0.3606 | 0.1729 | -0.0071 |
| 1000000. | -70.00 | 330.0000 | 0.3955 | -0.3567 | 0.1699 | 0.0171 |
| 1000000. | -70.00 | 345.0000 | 0.3929 | -0.3559 | 0.1610 | 0.0417 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 1000000. | -60.00 | 0. | 0.3391 | -0.3017 | 0.1414 | 0.0630 |
| 1000000. | -60.00 | 15.0000 | 0.3510 | -0.3179 | 0.1300 | 0.0725 |
| 1000000. | -60.00 | 30.0000 | 0.3713 | -0.3402 | 0.1228 | 0.0837 |
| 1000000. | -60.00 | 45.0000 | 0.3997 | -0.3722 | 0.1132 | 0.0917 |
| 1000000. | -60.00 | 60.0000 | 0.4255 | -0.4033 | 0.0970 | 0.0950 |
| 1000000. | -60.00 | 75.0000 | 0.4549 | -0.4367 | 0.0801 | 0.0992 |
| 1000000. | -60.00 | 90.0000 | 0.4918 | -0.4777 | 0.0679 | 0.0954 |
| 1000000. | -60.00 | 105.0000 | 0.5299 | -0.5209 | 0.0561 | 0.0796 |
| 1000000. | -60.00 | 120.0000 | 0.5599 | -0.5558 | 0.0463 | 0.0491 |
| 1000000. | -60.00 | 135.0000 | 0.5764 | -0.5744 | 0.0442 | 0.0170 |
| 1000000. | -60.00 | 150.0000 | 0.5877 | -0.5851 | 0.0549 | -0.0087 |
| 1000000. | -60.00 | 165.0000 | 0.6024 | -0.5967 | 0.0736 | -0.0377 |
| 1000000. | -60.00 | 180.0000 | 0.5923 | -0.5792 | 0.0954 | -0.0789 |
| 1000000. | -60.00 | 195.0000 | 0.5553 | -0.5339 | 0.1160 | -0.0991 |
| 1000000. | -60.00 | 210.0000 | 0.5208 | -0.4936 | 0.1320 | -0.1009 |
| 1000000. | -60.00 | 225.0000 | 0.4948 | -0.4646 | 0.1396 | -0.0974 |
| 1000000. | -60.00 | 240.0000 | 0.4714 | -0.4382 | 0.1419 | -0.1003 |
| 1000000. | -60.00 | 255.0000 | 0.4403 | -0.4003 | 0.1512 | -0.1036 |
| 1000000. | -60.00 | 270.0000 | 0.4041 | -0.3561 | 0.1662 | -0.0942 |
| 1000000. | -60.00 | 285.0000 | 0.3709 | -0.3152 | 0.1825 | -0.0699 |
| 1000000. | -60.00 | 300.0000 | 0.3493 | -0.2888 | 0.1936 | -0.0340 |
| 1000000. | -60.00 | 315.0000 | 0.3374 | -0.2779 | 0.1913 | 0.0007 |
| 1000000. | -60.00 | 330.0000 | 0.3306 | -0.2783 | 0.1762 | 0.0285 |
| 1000000. | -60.00 | 345.0000 | 0.3309 | -0.2866 | 0.1578 | 0.0493 |
| 1000000. | -50.00 | 0. | 0.2959 | -0.2583 | 0.1298 | 0.0632 |
| 1000000. | -50.00 | 15.0000 | 0.3126 | -0.2810 | 0.1201 | 0.0657 |
| 1000000. | -50.00 | 30.0000 | 0.3326 | -0.3037 | 0.1174 | 0.0681 |
| 1000000. | -50.00 | 45.0000 | 0.3566 | -0.3277 | 0.1177 | 0.0772 |
| 1000000. | -50.00 | 60.0000 | 0.3899 | -0.3626 | 0.1140 | 0.0870 |
| 1000000. | -50.00 | 75.0000 | 0.4305 | -0.4077 | 0.1032 | 0.0917 |
| 1000000. | -50.00 | 90.0000 | 0.4704 | -0.4535 | 0.0920 | 0.0844 |
| 1000000. | -50.00 | 105.0000 | 0.5143 | -0.5020 | 0.0884 | 0.0687 |
| 1000000. | -50.00 | 120.0000 | 0.5470 | -0.5378 | 0.0939 | 0.0353 |
| 1000000. | -50.00 | 135.0000 | 0.5640 | -0.5539 | 0.1064 | 0.0027 |
| 1000000. | -50.00 | 150.0000 | 0.5599 | -0.5444 | 0.1268 | -0.0313 |
| 1000000. | -50.00 | 165.0000 | 0.5513 | -0.5290 | 0.1471 | -0.0493 |
| 1000000. | -50.00 | 180.0000 | 0.5337 | -0.5040 | 0.1592 | -0.0744 |
| 1000000. | -50.00 | 195.0000 | 0.5037 | -0.4686 | 0.1637 | -0.0854 |
| 1000000. | -50.00 | 210.0000 | 0.4684 | -0.4293 | 0.1654 | -0.0877 |
| 1000000. | -50.00 | 225.0000 | 0.4414 | -0.3986 | 0.1711 | -0.0817 |
| 1000000. | -50.00 | 240.0000 | 0.4258 | -0.3768 | 0.1796 | -0.0338 |
| 1000000. | -50.00 | 255.0000 | 0.3976 | -0.3396 | 0.1858 | -0.0910 |
| 1000000. | -50.00 | 270.0000 | 0.3602 | -0.2918 | 0.1931 | -0.0855 |
| 1000000. | -50.00 | 285.0000 | 0.3212 | -0.2427 | 0.2003 | -0.0645 |
| 1000000. | -50.00 | 300.0000 | 0.2909 | -0.2109 | 0.1988 | -0.0244 |
| 1000000. | -50.00 | 315.0000 | 0.2778 | -0.2062 | 0.1856 | 0.0157 |
| 1000000. | -50.00 | 330.0000 | 0.2785 | -0.2195 | 0.1661 | 0.0423 |
| 1000000. | -50.00 | 345.0000 | 0.2837 | -0.2367 | 0.1455 | 0.0571 |

| R (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 1000000. | -40.00 | 0. | 0.2703 | -0.2347 | 0.1187 | 0.0626 |
| 1000000. | -40.00 | 15.0000 | 0.2887 | -0.2581 | 0.1171 | 0.0549 |
| 1000000. | -40.00 | 30.0000 | 0.3026 | -0.2714 | 0.1217 | 0.0557 |
| 1000000. | -40.00 | 45.0000 | 0.3274 | -0.2962 | 0.1241 | 0.0638 |
| 1000000. | -40.00 | 60.0000 | 0.3629 | -0.3305 | 0.1299 | 0.0750 |
| 1000000. | -40.00 | 75.0000 | 0.4123 | -0.3818 | 0.1318 | 0.0827 |
| 1000000. | -40.00 | 90.0000 | 0.4619 | -0.4361 | 0.1334 | 0.0733 |
| 1000000. | -40.00 | 105.0000 | 0.5018 | -0.4788 | 0.1411 | 0.0508 |
| 1000000. | -40.00 | 120.0000 | 0.5287 | -0.5054 | 0.1540 | 0.0194 |
| 1000000. | -40.00 | 135.0000 | 0.5378 | -0.5104 | 0.1691 | -0.0104 |
| 1000000. | -40.00 | 150.0000 | 0.5250 | -0.4928 | 0.1770 | -0.0379 |
| 1000000. | -40.00 | 165.0000 | 0.5102 | -0.4719 | 0.1865 | -0.0536 |
| 1000000. | -40.00 | 180.0000 | 0.4871 | -0.4395 | 0.1977 | -0.0710 |
| 1000000. | -40.00 | 195.0000 | 0.4538 | -0.3978 | 0.2050 | -0.0756 |
| 1000000. | -40.00 | 210.0000 | 0.4297 | -0.3706 | 0.2050 | -0.0726 |
| 1000000. | -40.00 | 225.0000 | 0.4065 | -0.3418 | 0.2072 | -0.0742 |
| 1000000. | -40.00 | 240.0000 | 0.3821 | -0.3103 | 0.2100 | -0.0750 |
| 1000000. | -40.00 | 255.0000 | 0.3536 | -0.2737 | 0.2098 | -0.0783 |
| 1000000. | -40.00 | 270.0000 | 0.3168 | -0.2266 | 0.2084 | -0.0745 |
| 1000000. | -40.00 | 285.0000 | 0.2759 | -0.1781 | 0.2038 | -0.0534 |
| 1000000. | -40.00 | 300.0000 | 0.2459 | -0.1481 | 0.1959 | -0.0124 |
| 1000000. | -40.00 | 315.0000 | 0.2377 | -0.1509 | 0.1814 | 0.0284 |
| 1000000. | -40.00 | 330.0000 | 0.2427 | -0.1738 | 0.1598 | 0.0563 |
| 1000000. | -40.00 | 345.0000 | 0.2554 | -0.2069 | 0.1343 | 0.0660 |
| 1000000. | -30.00 | 0. | 0.2664 | -0.2289 | 0.1214 | 0.0618 |
| 1000000. | -30.00 | 15.0000 | 0.2747 | -0.2423 | 0.1218 | 0.0438 |
| 1000000. | -30.00 | 30.0000 | 0.2892 | -0.2552 | 0.1274 | 0.0477 |
| 1000000. | -30.00 | 45.0000 | 0.3146 | -0.2780 | 0.1399 | 0.0466 |
| 1000000. | -30.00 | 60.0000 | 0.3429 | -0.3005 | 0.1540 | 0.0596 |
| 1000000. | -30.00 | 75.0000 | 0.3889 | -0.3441 | 0.1682 | 0.0674 |
| 1000000. | -30.00 | 90.0000 | 0.4359 | -0.3929 | 0.1800 | 0.0574 |
| 1000000. | -30.00 | 105.0000 | 0.4735 | -0.4297 | 0.1959 | 0.0349 |
| 1000000. | -30.00 | 120.0000 | 0.4930 | -0.4427 | 0.2169 | 0.0024 |
| 1000000. | -30.00 | 135.0000 | 0.4913 | -0.4323 | 0.2327 | -0.0183 |
| 1000000. | -30.00 | 150.0000 | 0.4836 | -0.4185 | 0.2395 | -0.0378 |
| 1000000. | -30.00 | 165.0000 | 0.4646 | -0.3904 | 0.2459 | -0.0547 |
| 1000000. | -30.00 | 180.0000 | 0.4373 | -0.3549 | 0.2471 | -0.0645 |
| 1000000. | -30.00 | 195.0000 | 0.4082 | -0.3222 | 0.2417 | -0.0663 |
| 1000000. | -30.00 | 210.0000 | 0.3861 | -0.2919 | 0.2439 | -0.0664 |
| 1000000. | -30.00 | 225.0000 | 0.3608 | -0.2599 | 0.2417 | -0.0650 |
| 1000000. | -30.00 | 240.0000 | 0.3369 | -0.2322 | 0.2356 | -0.0640 |
| 1000000. | -30.00 | 255.0000 | 0.3125 | -0.2015 | 0.2295 | -0.0662 |
| 1000000. | -30.00 | 270.0000 | 0.2815 | -0.1598 | 0.2234 | -0.0619 |
| 1000000. | -30.00 | 285.0000 | 0.2498 | -0.1193 | 0.2157 | -0.0407 |
| 1000000. | -30.00 | 300.0000 | 0.2248 | -0.0974 | 0.2026 | -0.0003 |
| 1000000. | -30.00 | 315.0000 | 0.2172 | -0.1087 | 0.1837 | 0.0404 |
| 1000000. | -30.00 | 330.0000 | 0.2263 | -0.1436 | 0.1608 | 0.0689 |
| 1000000. | -30.00 | 345.0000 | 0.2481 | -0.1917 | 0.1384 | 0.0750 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 1000000. | -20.00 | 0. | 0.2746 | -0.2186 | 0.1536 | 0.0635 |
| 1000000. | -20.00 | 15.0000 | 0.2822 | -0.2364 | 0.1493 | 0.0383 |
| 1000000. | -20.00 | 30.0000 | 0.2918 | -0.2420 | 0.1596 | 0.0334 |
| 1000000. | -20.00 | 45.0000 | 0.3084 | -0.2498 | 0.1781 | 0.0322 |
| 1000000. | -20.00 | 60.0000 | 0.3317 | -0.2656 | 0.1940 | 0.0431 |
| 1000000. | -20.00 | 75.0000 | 0.3653 | -0.2930 | 0.2121 | 0.0511 |
| 1000000. | -20.00 | 90.0000 | 0.4070 | -0.3336 | 0.2296 | 0.0410 |
| 1000000. | -20.00 | 105.0000 | 0.4340 | -0.3522 | 0.2531 | 0.0155 |
| 1000000. | -20.00 | 120.0000 | 0.4405 | -0.3461 | 0.2723 | -0.0088 |
| 1000000. | -20.00 | 135.0000 | 0.4342 | -0.3318 | 0.2792 | -0.0226 |
| 1000000. | -20.00 | 150.0000 | 0.4237 | -0.3142 | 0.2818 | -0.0372 |
| 1000000. | -20.00 | 165.0000 | 0.4035 | -0.2866 | 0.2796 | -0.0500 |
| 1000000. | -20.00 | 180.0000 | 0.3812 | -0.2542 | 0.2779 | -0.0590 |
| 1000000. | -20.00 | 195.0000 | 0.3620 | -0.2248 | 0.2774 | -0.0592 |
| 1000000. | -20.00 | 210.0000 | 0.3377 | -0.1940 | 0.2703 | -0.0578 |
| 1000000. | -20.00 | 225.0000 | 0.3175 | -0.1694 | 0.2626 | -0.0562 |
| 1000000. | -20.00 | 240.0000 | 0.3012 | -0.1480 | 0.2567 | -0.0538 |
| 1000000. | -20.00 | 255.0000 | 0.2836 | -0.1223 | [illegible] | -0.0564 |
| 1000000. | -20.00 | 270.0000 | 0.2619 | -0.0880 | 0.2413 | -0.0510 |
| 1000000. | -20.00 | 285.0000 | 0.2400 | -0.0543 | 0.2318 | -0.0301 |
| 1000000. | -20.00 | 300.0000 | 0.2225 | -0.0414 | 0.2184 | 0.0111 |
| 1000000. | -20.00 | 315.0000 | 0.2174 | -0.0618 | 0.2019 | 0.0517 |
| 1000000. | -20.00 | 330.0000 | 0.2266 | -0.1070 | 0.1840 | 0.0777 |
| 1000000. | -20.00 | 345.0000 | 0.2495 | -0.1675 | 0.1649 | 0.0837 |
| 1000000. | -10.00 | 0. | 0.2726 | -0.1747 | 0.2003 | 0.0608 |
| 1000000. | -10.00 | 15.0000 | 0.2873 | -0.1982 | 0.2050 | 0.0352 |
| 1000000. | -10.00 | 30.0000 | 0.2935 | -0.1995 | 0.2142 | 0.0210 |
| 1000000. | -10.00 | 45.0000 | 0.3018 | -0.1935 | 0.2309 | 0.0186 |
| 1000000. | -10.00 | 60.0000 | 0.3202 | -0.2008 | 0.2476 | 0.0306 |
| 1000000. | -10.00 | 75.0000 | 0.3450 | -0.2206 | 0.2627 | 0.0369 |
| 1000000. | -10.00 | 90.0000 | 0.3755 | -0.2489 | 0.2798 | 0.0267 |
| 1000000. | -10.00 | 105.0000 | 0.3874 | -0.2506 | 0.2955 | 0.0004 |
| 1000000. | -10.00 | 120.0000 | 0.3859 | -0.2303 | 0.3092 | -0.0166 |
| 1000000. | -10.00 | 135.0000 | 0.3793 | -0.2116 | 0.3140 | -0.0224 |
| 1000000. | -10.00 | 150.0000 | [illegible] | -0.1962 | 0.3097 | -0.0332 |
| 1000000. | -10.00 | 165.0000 | [illegible] | -0.1727 | 0.3051 | -0.0461 |
| 1000000. | -10.00 | 180.0000 | 0.3361 | -0.1421 | 0.2999 | -0.0531 |
| 1000000. | -10.00 | 195.0000 | 0.3166 | -0.1145 | 0.2905 | [illegible] |
| 1000000. | -10.00 | 210.0000 | 0.3018 | -0.0924 | 0.2829 | -0.0502 |
| 1000000. | -10.00 | 225.0000 | 0.2888 | -0.0743 | 0.2749 | -0.0479 |
| 1000000. | -10.00 | 240.0000 | 0.2780 | -0.0572 | 0.2679 | -0.0476 |
| 1000000. | -10.00 | 255.0000 | 0.2709 | -0.0368 | 0.2638 | -0.0492 |
| 1000000. | -10.00 | 270.0000 | 0.2632 | -0.0061 | 0.2593 | -0.0445 |
| 1000000. | -10.00 | 285.0000 | 0.2538 | 0.0243 | 0.2517 | -0.0217 |
| 1000000. | -10.00 | 300.0000 | 0.2430 | 0.0320 | 0.2400 | 0.0210 |
| 1000000. | -10.00 | 315.0000 | 0.2320 | 0.0019 | 0.2240 | 0.0605 |
| 1000000. | -10.00 | 330.0000 | 0.2313 | -0.0532 | 0.2082 | 0.0855 |
| 1000000. | -10.00 | 345.0000 | 0.2502 | -0.1230 | 0.1996 | 0.0874 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 1000000. | 0.00 | 0. | 0.2677 | -0.1015 | 0.2417 | 0.0543 |
| 1000000. | 0.00 | 15.0000 | 0.2821 | -0.1157 | 0.2558 | 0.0282 |
| 1000000. | 0.00 | 30.0000 | 0.2906 | -0.1139 | 0.2671 | 0.0124 |
| 1000000. | 0.00 | 45.0000 | 0.2958 | -0.1012 | 0.2779 | 0.0086 |
| 1000000. | 0.00 | 60.0000 | 0.3100 | -0.0988 | 0.2932 | 0.0191 |
| 1000000. | 0.00 | 75.0000 | 0.3291 | -0.1132 | 0.3079 | 0.0261 |
| 1000000. | 0.00 | 90.0000 | 0.3494 | -0.1326 | 0.3228 | 0.0165 |
| 1000000. | 0.00 | 105.0000 | 0.3568 | -0.1276 | 0.3332 | -0.0063 |
| 1000000. | 0.00 | 120.0000 | 0.3474 | -0.1034 | 0.3311 | -0.0177 |
| 1000000. | 0.00 | 135.0000 | 0.3346 | -0.0864 | 0.3227 | -0.0188 |
| 1000000. | 0.00 | 150.0000 | 0.3236 | -0.0746 | 0.3137 | -0.027[illegible] |
| 1000000. | 0.00 | 165.0000 | 0.3109 | -0.0546 | 0.3032 | -0.0420 |
| 1000000. | 0.00 | 180.0000 | 0.2995 | -0.0262 | 0.2947 | -0.0466 |
| 1000000. | 0.00 | 195.0000 | 0.2941 | -0.0036 | 0.2904 | -0.0467 |
| 1000000. | 0.00 | 210.0000 | 0.2873 | 0.0117 | 0.2836 | -0.0445 |
| 1000000. | 0.00 | 225.0000 | 0.2834 | 0.0241 | 0.2791 | -0.0430 |
| 1000000. | 0.00 | 240.0000 | 0.2844 | 0.0378 | 0.2782 | -0.0453 |
| 1000000. | 0.00 | 255.0000 | 0.2858 | 0.0596 | 0.2758 | -0.0458 |
| 1000000. | 0.00 | 270.0000 | 0.2881 | 0.0900 | 0.2707 | -0.0405 |
| 1000000. | 0.00 | 285.0000 | 0.2891 | 0.1190 | 0.2632 | -0.0139 |
| 1000000. | 0.00 | 300.0000 | 0.2781 | 0.1193 | 0.2496 | 0.0291 |
| 1000000. | 0.00 | 315.0000 | 0.2633 | 0.0821 | 0.2409 | 0.0675 |
| 1000000. | 0.00 | 330.0000 | 0.2525 | 0.0191 | 0.2347 | 0.0911 |
| 1000000. | 0.00 | 345.0000 | 0.2533 | -0.0545 | 0.2322 | 0.0854 |
| 1000000. | 10.00 | 0. | 0.2763 | -0.0012 | 0.2727 | 0.0444 |
| 1000000. | 10.00 | 15.0000 | 0.2856 | -0.0050 | 0.2848 | 0.0209 |
| 1000000. | 10.00 | 30.0000 | 0.2948 | 0.0034 | 0.2948 | 0.0056 |
| 1000000. | 10.00 | 45.0000 | 0.3036 | 0.0162 | 0.3031 | 0.0020 |
| 1000000. | 10.00 | 60.0000 | 0.3163 | 0.0247 | 0.3152 | 0.0086 |
| 1000000. | 10.00 | 75.0000 | 0.3318 | 0.0167 | 0.3310 | 0.0163 |
| 1000000. | 10.00 | 90.0000 | 0.3447 | 0.0061 | 0.3445 | 0.0097 |
| 1000000. | 10.00 | 105.0000 | 0.3435 | 0.0114 | 0.3432 | -0.0061 |
| 1000000. | 10.00 | 120.0000 | 0.3363 | 0.0261 | 0.3351 | -0.0108 |
| 1000000. | 10.00 | 135.0000 | 0.3230 | 0.0343 | 0.3210 | -0.0108 |
| 1000000. | 10.00 | 150.0000 | 0.3067 | 0.0375 | 0.3038 | -0.0188 |
| 1000000. | 10.00 | 165.0000 | 0.2972 | 0.0519 | 0.2906 | -0.0348 |
| 1000000. | 10.00 | 180.0000 | 0.2908 | 0.0732 | 0.2784 | -0.0413 |
| 1000000. | 10.00 | 195.0000 | 0.2891 | 0.0938 | 0.2698 | -0.0444 |
| 1000000. | 10.00 | 210.0000 | 0.294[illegible] | 0.1096 | 0.2697 | -0.0437 |
| 1000000. | 10.00 | 225.0000 | 0.3023 | 0.1231 | 0.2725 | -0.0444 |
| 1000000. | 10.00 | 240.0000 | 0.3121 | 0.1413 | 0.2745 | -0.0457 |
| 1000000. | 10.00 | 255.0000 | 0.3230 | 0.1643 | 0.2744 | -0.0449 |
| 1000000. | 10.00 | 270.0000 | 0.3353 | 0.1950 | 0.2703 | -0.0367 |
| 1000000. | 10.00 | 285.0000 | 0.3399 | 0.2213 | 0.2580 | -0.0054 |
| 1000000. | 10.00 | 300.0000 | 0.3265 | 0.2117 | 0.2459 | 0.0368 |
| 1000000. | 10.00 | 315.0000 | 0.3042 | 0.1726 | 0.2403 | 0.0708 |
| 1000000. | 10.00 | 330.0000 | 0.2820 | 0.1081 | 0.2435 | 0.0923 |
| 1000000. | 10.00 | 345.0000 | 0.2704 | 0.0331 | 0.2561 | 0.0805 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 1000000. | 20.00 | 0. | 0.3029 | 0.1142 | 0.2781 | 0.0371 |
| 1000000. | 20.00 | 15.0000 | 0.3087 | 0.1142 | 0.2864 | 0.0167 |
| 1000000. | 20.00 | 30.0000 | 0.3196 | 0.1264 | 0.2935 | -0.0006 |
| 1000000. | 20.00 | 45.0000 | 0.3327 | 0.1405 | 0.3016 | -0.0049 |
| 1000000. | 20.00 | 60.0000 | 0.3484 | 0.1540 | 0.3125 | 0.0001 |
| 1000000. | 20.00 | 75.0000 | 0.3622 | 0.1565 | 0.3266 | 0.0056 |
| 1000000. | 20.00 | 90.0000 | 0.3703 | 0.1539 | 0.3368 | 0.0056 |
| 1000000. | 20.00 | 105.0000 | 0.3699 | 0.1515 | 0.3374 | -0.0013 |
| 1000000. | 20.00 | 120.0000 | 0.3610 | 0.1575 | 0.3248 | -0.0009 |
| 1000000. | 20.00 | 135.0000 | 0.3398 | 0.1488 | 0.3055 | 0.0021 |
| 1000000. | 20.00 | 150.0000 | 0.3183 | 0.1375 | 0.2870 | -0.0072 |
| 1000000. | 20.00 | 165.0000 | 0.3025 | 0.1402 | 0.2668 | -0.0253 |
| 1000000. | 20.00 | 180.0000 | 0.3010 | 0.1567 | 0.2543 | -0.0369 |
| 1000000. | 20.00 | 195.0000 | 0.3097 | 0.1763 | 0.2506 | -0.0447 |
| 1000000. | 20.00 | 210.0000 | 0.3211 | 0.1956 | 0.2502 | -0.0478 |
| 1000000. | 20.00 | 225.0000 | 0.3392 | 0.2182 | 0.2550 | -0.0495 |
| 1000000. | 20.00 | 240.0000 | 0.3592 | 0.2429 | 0.2600 | -0.0497 |
| 1000000. | 20.00 | 255.0000 | 0.3780 | 0.2704 | 0.2601 | -0.0458 |
| 1000000. | 20.00 | 270.0000 | 0.3930 | 0.3012 | 0.2506 | -0.0302 |
| 1000000. | 20.00 | 285.0000 | 0.3947 | 0.3167 | 0.2355 | 0.0048 |
| 1000000. | 20.00 | 300.0000 | 0.3765 | 0.2985 | 0.2253 | 0.0437 |
| 1000000. | 20.00 | 315.0000 | 0.3475 | 0.2544 | 0.2253 | 0.0727 |
| 1000000. | 20.00 | 330.0000 | 0.3194 | 0.1952 | 0.2372 | 0.0874 |
| 1000000. | 00 | 345.0000 | 0.3033 | 0.1379 | 0.2612 | 0.0690 |
| 1000000. | 30.00 | 0. | 0.3431 | 0.2271 | 0.2554 | 0.0308 |
| 1000000. | 30.00 | 15.0000 | 0.3475 | 0.2262 | 0.2634 | 0.0142 |
| 1000000. | 30.00 | 30.0000 | 0.3577 | 0.2376 | 0.2673 | -0.0049 |
| 1000000. | 30.00 | 45.0000 | 0.3743 | 0.2561 | 0.2728 | -0.0117 |
| 1000000. | 30.00 | 60.0000 | 0.3928 | 0.2747 | 0.2806 | -0.0087 |
| 1000000. | 30.00 | 75.0000 | 0.4052 | 0.2830 | 0.2900 | -0.0028 |
| 1000000. | 30.00 | 90.0000 | 0.4146 | 0.2856 | 0.3005 | 0.0009 |
| 1000000. | 30.00 | 105.0000 | 0.4152 | 0.2844 | 0.3025 | 0.0028 |
| 1000000. | 30.00 | 120.0000 | 0.4039 | 0.2772 | 0.2935 | 0.0104 |
| 1000000. | 30.00 | 135.0000 | 0.3822 | 0.2571 | 0.2824 | 0.0148 |
| 1000000. | 30.00 | 150.0000 | 0.3546 | 0.2334 | 0.2669 | 0.0060 |
| 1000000. | 30.00 | 165.0000 | 0.3348 | 0.2213 | 0.2510 | -0.0133 |
| 1000000. | 30.00 | 180.0000 | 0.3290 | 0.2275 | 0.2353 | -0.0330 |
| 1000000. | 30.00 | 195.0000 | 0.3401 | 0.2482 | 0.2280 | -0.0463 |
| 1000000. | 30.00 | 210.0000 | 0.3585 | 0.2723 | 0.2270 | -0.0531 |
| 1000000. | 30.00 | 225.0000 | 0.3843 | 0.3035 | 0.2285 | -0.0578 |
| 1000000. | 30.00 | 240.0000 | 0.4110 | 0.3372 | 0.2286 | -0.0547 |
| 1000000. | 30.00 | 255.0000 | 0.4357 | 0.3705 | 0.2248 | -0.0453 |
| 1000000. | 30.00 | 270.0000 | 0.4490 | 0.3944 | 0.2136 | -0.0213 |
| 1000000. | 30.00 | 285.0000 | 0.4452 | 0.3973 | 0.2005 | 0.0141 |
| 1000000. | 30.00 | 300.0000 | 0.4244 | 0.3732 | 0.1957 | 0.0499 |
| 1000000. | 30.00 | 315.0000 | 0.3930 | 0.3296 | 0.2012 | 0.0729 |
| 1000000. | 30.00 | 330.0000 | 0.3600 | 0.2757 | 0.2185 | 0.0765 |
| 1000000. | 30.00 | 345.0000 | 0.3469 | 0.2413 | 0.2421 | 0.0594 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 1000000. | 40.00 | 0. | 0.3784 | 0.3111 | 0.2137 | 0.0283 |
| 1000000. | 40.00 | 15.0000 | 0.3821 | 0.3125 | 0.2196 | 0.0097 |
| 1000000. | 40.00 | 30.0000 | 0.3947 | 0.3254 | 0.2233 | -0.0069 |
| 1000000. | 40.00 | 45.0000 | 0.4104 | 0.3431 | 0.2245 | -0.0174 |
| 1000000. | 40.00 | 60.0000 | 0.4318 | 0.3652 | 0.2298 | -0.0173 |
| 1000000. | 40.00 | 75.0000 | 0.4491 | 0.3799 | 0.2393 | -0.0114 |
| 1000000. | 40.00 | 90.0000 | 0.4627 | 0.3912 | 0.2470 | -0.0070 |
| 1000000. | 40.00 | 105.0000 | 0.4697 | 0.3957 | 0.2529 | 0.0051 |
| 1000000. | 40.00 | 120.0000 | 0.4573 | 0.3820 | 0.2507 | 0.0183 |
| 1000000. | 40.00 | 135.0000 | 0.4303 | 0.3533 | 0.2442 | 0.0264 |
| 1000000. | 40.00 | 150.0000 | 0.3966 | 0.3179 | 0.2364 | 0.0179 |
| 1000000. | 40.00 | 165.0000 | 0.3755 | 0.2984 | 0.2279 | -0.0034 |
| 1000000. | 40.00 | 180.0000 | 0.3692 | 0.2965 | 0.2182 | -0.0286 |
| 1000000. | 40.00 | 195.0000 | 0.3826 | 0.3172 | 0.2088 | -0.0466 |
| 1000000. | 40.00 | 210.0000 | 0.4037 | 0.3445 | 0.2021 | -0.0587 |
| 1000000. | 40.00 | 225.0000 | 0.4316 | 0.3792 | 0.1963 | -0.0627 |
| 1000000. | 40.00 | 240.0000 | 0.4596 | 0.4151 | 0.1886 | -0.0578 |
| 1000000. | 40.00 | 255.0000 | 0.4848 | 0.4493 | 0.1772 | -0.0420 |
| 1000000. | 40.00 | 270.0000 | 0.4944 | 0.4666 | 0.1628 | -0.0124 |
| 1000000. | 40.00 | 285.0000 | 0.4860 | 0.4605 | 0.1537 | 0.0222 |
| 1000000. | 40.00 | 300.0000 | 0.4603 | 0.4305 | 0.1536 | 0.0546 |
| 1000000. | 40.00 | 315.0000 | 0.4310 | 0.3914 | 0.1667 | 0.0688 |
| 1000000. | 40.00 | 330.0000 | 0.4047 | 0.3524 | 0.1879 | 0.0656 |
| 1000000. | 40.00 | 345.0000 | 0.3910 | 0.3289 | 0.2041 | 0.0554 |
| 1000000. | 50.00 | 0. | 0.4103 | 0.3721 | 0.1710 | 0.0261 |
| 1000000. | 50.00 | 15.0000 | 0.4149 | 0.3751 | 0.1772 | 0.0070 |
| 1000000. | 50.00 | 30.0000 | 0.4241 | 0.3851 | 0.1773 | -0.0089 |
| 1000000. | 50.00 | 45.0000 | 0.4404 | 0.4027 | 0.1770 | -0.0211 |
| 1000000. | 50.00 | 60.0000 | 0.4623 | 0.4268 | 0.1758 | -0.0257 |
| 1000000. | 50.00 | 75.0000 | 0.4826 | 0.4478 | 0.1788 | -0.0208 |
| 1000000. | 50.00 | 90.0000 | 0.4994 | 0.4639 | 0.1843 | -0.0138 |
| 1000000. | 50.00 | 105.0000 | 0.5056 | 0.4705 | 0.1851 | 0.0039 |
| 1000000. | 50.00 | 120.0000 | 0.4973 | 0.4588 | 0.1908 | 0.0196 |
| 1000000. | 50.00 | 135.0000 | 0.4778 | 0.4328 | 0.2001 | 0.0307 |
| 1000000. | 50.00 | 150.0000 | 0.4500 | 0.3991 | 0.2066 | 0.0233 |
| 1000000. | 50.00 | 165.0000 | 0.4310 | 0.3790 | 0.2052 | 0.0038 |
| 1000000. | 50.00 | 180.0000 | 0.4186 | 0.3700 | 0.1947 | -0.0211 |
| 1000000. | 50.00 | 195.0000 | 0.4249 | 0.3822 | 0.1804 | -0.0440 |
| 1000000. | 50.00 | 210.0000 | 0.4440 | 0.4069 | 0.1668 | -0.0604 |
| 1000000. | 50.00 | 225.0000 | 0.4726 | 0.4425 | 0.1532 | -0.0637 |
| 1000000. | 50.00 | 240.0000 | 0.4980 | 0.4754 | 0.1375 | -0.0553 |
| 1000000. | 50.00 | 255.0000 | 0.5138 | 0.4988 | 0.1189 | -0.0320 |
| 1000000. | 50.00 | 270.0000 | 0.5133 | 0.5027 | 0.1036 | -0.0026 |
| 1000000. | 50.00 | 285.0000 | 0.5044 | 0.4937 | 0.0998 | 0.0264 |
| 1000000. | 50.00 | 300.0000 | 0.4850 | 0.4691 | 0.1111 | 0.0536 |
| 1000000. | 50.00 | 315.0000 | 0.4584 | 0.4363 | 0.1252 | 0.0645 |
| 1000000. | 50.00 | 330.0000 | 0.4329 | 0.4047 | 0.1405 | 0.0621 |
| 1000000. | 50.00 | 345.0000 | 0.4158 | 0.3822 | 0.1565 | 0.0483 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 1000000. | 60.00 | 0. | 0.4358 | 0.4153 | 0.1300 | 0.0231 |
| 1000000. | 60.00 | 15.0000 | 0.4391 | 0.4181 | 0.1338 | 0.0062 |
| 1000000. | 60.00 | 30.0000 | 0.4460 | 0.4256 | 0.1331 | -0.0090 |
| 1000000. | 60.00 | 45.0000 | 0.4576 | 0.4391 | 0.1272 | -0.0214 |
| 1000000. | 60.00 | 60.0000 | 0.4731 | 0.4563 | 0.1214 | -0.0298 |
| 1000000. | 60.00 | 75.0000 | 0.4980 | 0.4821 | 0.1203 | -0.0332 |
| 1000000. | 60.00 | 90.0000 | 0.5223 | 0.5075 | 0.1220 | -0.0209 |
| 1000000. | 60.00 | 105.0000 | 0.5287 | 0.5129 | 0.1283 | -0.0017 |
| 1000000. | 60.00 | 120.0000 | 0.5282 | 0.5099 | 0.1370 | 0.0128 |
| 1000000. | 60.00 | 135.0000 | 0.5151 | 0.4935 | 0.1450 | 0.0275 |
| 1000000. | 60.00 | 150.0000 | 0.4909 | 0.4662 | 0.1520 | 0.0234 |
| 1000000. | 60.00 | 165.0000 | 0.4746 | 0.4482 | 0.1558 | 0.0076 |
| 1000000. | 60.00 | 180.0000 | 0.4635 | 0.4365 | 0.1553 | -0.0140 |
| 1000000. | 60.00 | 195.0000 | 0.4660 | 0.4411 | 0.1453 | -0.0381 |
| 1000000. | 60.00 | 210.0000 | 0.4797 | 0.4591 | 0.1281 | -0.0540 |
| 1000000. | 60.00 | 225.0000 | 0.4992 | 0.4845 | 0.1058 | -0.0569 |
| 1000000. | 60.00 | 240.0000 | 0.5159 | 0.5070 | 0.0843 | -0.0453 |
| 1000000. | 60.00 | 255.0000 | 0.5243 | 0.5193 | 0.0685 | -0.0209 |
| 1000000. | 60.00 | 270.0000 | 0.5166 | 0.5129 | 0.0606 | 0.0085 |
| 1000000. | 60.00 | 285.0000 | 0.5024 | 0.4980 | 0.0596 | 0.0287 |
| 1000000. | 60.00 | 300.0000 | 0.4922 | 0.4852 | 0.0678 | 0.0481 |
| 1000000. | 60.00 | 315.0000 | 0.4717 | 0.4599 | 0.0848 | 0.0616 |
| 1000000. | 60.00 | 330.0000 | 0.4495 | 0.4337 | 0.1038 | 0.0564 |
| 1000000. | 60.00 | 345.0000 | 0.4387 | 0.4199 | 0.1201 | 0.0412 |
| 1000000. | 70.00 | 0. | 0.4564 | 0.4460 | 0.0943 | 0.0214 |
| 1000000. | 70.00 | 15.0000 | 0.4585 | 0.4479 | 0.0978 | 0.0068 |
| 1000000. | 70.00 | 30.0000 | 0.4621 | 0.4519 | 0.0967 | -0.0061 |
| 1000000. | 70.00 | 45.0000 | 0.4673 | 0.4576 | 0.0928 | -0.0187 |
| 1000000. | 70.00 | 60.0000 | 0.4786 | 0.4697 | 0.0860 | -0.0316 |
| 1000000. | 70.00 | 75.0000 | 0.4986 | 0.4913 | 0.0761 | -0.0380 |
| 1000000. | 70.00 | 90.0000 | 0.5199 | 0.5145 | 0.0680 | -0.0312 |
| 1000000. | 70.00 | 105.0000 | 0.5353 | 0.5308 | 0.0670 | -0.0161 |
| 1000000. | 70.00 | 120.0000 | 0.5415 | 0.5367 | 0.0722 | 0.0026 |
| 1000000. | 70.00 | 135.0000 | 0.5333 | 0.5264 | 0.0838 | 0.0185 |
| 1000000. | 70.00 | 150.0000 | 0.5166 | 0.5070 | 0.0974 | 0.0182 |
| 1000000. | 70.00 | 165.0000 | 0.5044 | 0.4935 | 0.1044 | 0.0050 |
| 1000000. | 70.00 | 180.0000 | 0.4986 | 0.4876 | 0.1033 | -0.0115 |
| 1000000. | 70.00 | 195.0000 | 0.4977 | 0.4881 | 0.0935 | -0.0277 |
| 1000000. | 70.00 | 210.0000 | 0.5018 | 0.4944 | 0.0766 | -0.0386 |
| 1000000. | 70.00 | 225.0000 | 0.5089 | 0.5041 | 0.0569 | -0.0402 |
| 1000000. | 70.00 | 240.0000 | 0.5168 | 0.5143 | 0.0390 | -0.0317 |
| 1000000. | 70.00 | 255.0000 | 0.5223 | 0.5214 | 0.0267 | -0.0124 |
| 1000000. | 70.00 | 270.0000 | 0.5190 | 0.5183 | 0.0238 | 0.0128 |
| 1000000. | 70.00 | 285.0000 | 0.5074 | 0.5055 | 0.0286 | 0.0332 |
| 1000000. | 70.00 | 300.0000 | 0.4935 | 0.4898 | 0.0381 | 0.0471 |
| 1000000. | 70.00 | 315.0000 | 0.4782 | 0.4721 | 0.0535 | 0.0536 |
| 1000000. | 70.00 | 330.0000 | 0.4649 | 0.4568 | 0.0713 | 0.0485 |
| 1000000. | 70.00 | 345.0000 | 0.4580 | 0.4485 | 0.0854 | 0.0361 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 1000000. | 80.00 | 0. | 0.4769 | 0.4725 | 0.0619 | 0.0193 |
| 1000000. | 80.00 | 15.0000 | 0.4778 | 0.4732 | 0.0659 | 0.0074 |
| 1000000. | 80.00 | 30.0000 | 0.4803 | 0.4756 | 0.0662 | -0.0050 |
| 1000000. | 80.00 | 45.0000 | 0.4847 | 0.4804 | 0.0626 | -0.0169 |
| 1000000. | 80.00 | 60.0000 | 0.4916 | 0.4878 | 0.0551 | -0.0264 |
| 1000000. | 80.00 | 75.0000 | 0.5003 | 0.4973 | 0.0448 | -0.0312 |
| 1000000. | 80.00 | 90.0000 | 0.5093 | 0.5073 | 0.0344 | -0.0299 |
| 1000000. | 80.00 | 105.0000 | 0.5169 | 0.5157 | 0.0269 | -0.0230 |
| 1000000. | 80.00 | 120.0000 | 0.5216 | 0.5208 | 0.0245 | -0.0133 |
| 1000000. | 80.00 | 135.0000 | 0.5225 | 0.5217 | 0.0273 | -0.0049 |
| 1000000. | 80.00 | 150.0000 | 0.5202 | 0.5192 | 0.0328 | -0.0011 |
| 1000000. | 80.00 | 165.0000 | 0.5163 | 0.5150 | 0.0373 | -0.0028 |
| 1000000. | 80.00 | 180.0000 | 0.5122 | 0.5107 | 0.0380 | -0.0082 |
| 1000000. | 80.00 | 195.0000 | 0.5090 | 0.5077 | 0.0338 | -0.0144 |
| 1000000. | 80.00 | 210.0000 | 0.5074 | 0.5064 | 0.0254 | -0.0186 |
| 1000000. | 80.00 | 225.0000 | 0.5073 | 0.5068 | 0.0143 | -0.0181 |
| 1000000. | 80.00 | 240.0000 | 0.5078 | 0.5076 | 0.0037 | -0.0112 |
| 1000000. | 80.00 | 255.0000 | 0.5071 | 0.5071 | -0.0033 | 0.0014 |
| 1000000. | 80.00 | 270.0000 | 0.5040 | 0.5037 | -0.0038 | 0.0168 |
| 1000000. | 80.00 | 285.0000 | 0.4982 | 0.4973 | 0.0027 | 0.0307 |
| 1000000. | 80.00 | 300.0000 | 0.4912 | 0.4894 | 0.0145 | 0.0396 |
| 1000000. | 80.00 | 315.0000 | 0.4847 | 0.4820 | 0.0288. | 0.0419 |
| 1000000. | 80.00 | 330.0000 | 0.4800 | 0.4765 | 0.0427 | 0.0382 |
| 1000000. | 80.00 | 345.0000 | 0.4779 | 0.4734 | 0.0541 | 0.0300 |
| 1000000. | 90.00 | 0. | 0.5003 | 0.4996 | 0 | 0 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 2000000. | -90.00 | 0. | 0.4330 | -0.4204 | 0 | 0 |
| 2000000. | -80.00 | 0. | 0.3973 | -0.3786 | 0.1056 | 0.0582 |
| 2000000. | -80.00 | 15.0000 | 0.4028 | -0.3858 | 0.0890 | 0.0741 |
| 2000000. | -80.00 | 30.0000 | 0.4092 | -0.3942 | 0.0694 | 0.0851 |
| 2000000. | -80.00 | 45.0000 | 0.4162 | -0.4031 | 0.0483 | 0.0913 |
| 2000000. | -80.00 | 60.0000 | 0.4238 | -0.4125 | 0.0265 | 0.0935 |
| 2000000. | -80.00 | 75.0000 | 0.4326 | -0.4228 | 0.0041 | 0.0913 |
| 2000000. | -80.00 | 90.0000 | 0.4425 | -0.4341 | -0.0180 | 0.0838 |
| 2000000. | -80.00 | 105.0000 | 0.4529 | -0.4458 | -0.0377 | 0.0701 |
| 2000000. | -80.00 | 120.0000 | 0.4630 | -0.4571 | -0.0533 | 0.0510 |
| 2000000. | -80.00 | 135.0000 | 0.4722 | -0.4671 | -0.0637 | 0.0276 |
| 2000000. | -80.00 | 150.0000 | 0.4795 | -0.4746 | -0.0685 | 0.0003 |
| 2000000. | -80.00 | 165.0000 | 0.4832 | -0.4777 | -0.0666 | -0.0300 |
| 2000000. | -80.00 | 180.0000 | 0.4813 | -0.4741 | -0.0562 | -0.0606 |
| 2000000. | -80.00 | 195.0000 | 0.4730 | -0.4635 | -0.0372 | -0.0868 |
| 2000000. | -80.00 | 210.0000 | 0.4596 | -0.4474 | -0.0116 | -0.1045 |
| 2000000. | -80.00 | 225.0000 | 0.4436 | -0.4290 | 0.0171 | -0.1117 |
| 2000000. | -80.00 | 240.0000 | 0.4280 | -0.4113 | 0.0459 | -0.1089 |
| 2000000. | -80.00 | 255.0000 | 0.4146 | -0.3964 | 0.0724 | -0.0977 |
| 2000000. | -80.00 | 270.0000 | 0.4045 | -0.3850 | 0.0948 | -0.0800 |
| 2000000. | -80.00 | 285.0000 | 0.3976 | -0.3772 | 0.1116 | -0.0579 |
| 2000000. | -80.00 | 300.0000 | 0.3935 | -0.3726 | 0.1222 | -0.0335 |
| 2000000. | -80.00 | 315.0000 | 0.3917 | -0.3707 | 0.1264 | -0.0086 |
| 2000000. | -80.00 | 330.0000 | 0.3918 | -0.3710 | 0.1248 | 0.0156 |
| 2000000. | -80.00 | 345.0000 | 0.3936 | -0.3736 | 0.1177 | 0.0382 |
| 2000000. | -70.00 | 0. | 0.3514 | -0.3237 | 0.1247 | 0.0564 |
| 2000000. | -70.00 | 15.0000 | 0.3623 | -0.3375 | 0.1109 | 0.0709 |
| 2000000. | -70.00 | 30.0000 | 0.3766 | -0.3554 | 0.0952 | 0.0804 |
| 2000000. | -70.00 | 45.0000 | 0.3910 | -0.3736 | 0.0778 | 0.0848 |
| 2000000. | -70.00 | 60.0000 | 0.4050 | -0.3909 | 0.0597 | 0.0874 |
| 2000000. | -70.00 | 75.0000 | 0.4231 | -0.4116 | 0.0403 | 0.0891 |
| 2000000. | -70.00 | 90.0000 | 0.4461 | -0.4377 | 0.0196 | 0.0841 |
| 2000000. | -70.00 | 105.0000 | 0.4678 | -0.4628 | 0.0013 | 0.0681 |
| 2000000. | -70.00 | 120.0000 | 0.4828 | -0.4806 | -0.0102 | 0.0449 |
| 2000000. | -70.00 | 135.0000 | 0.4928 | -0.4921 | -0.0137 | 0.0216 |
| 2000000. | -70.00 | 150.0000 | 0.5030 | -0.5029 | -0.0117 | -0.0009 |
| 2000000. | -70.00 | 165.0000 | 0.5123 | -0.5115 | -0.0055 | -0.0281 |
| 2000000. | -70.00 | 180.0000 | 0.5122 | -0.5087 | 0.0073 | -0.0592 |
| 2000000. | -70.00 | 195.0000 | 0.4989 | -0.4911 | 0.0255 | -0.0843 |
| 2000000. | -70.00 | 210.0000 | 0.4769 | -0.4646 | 0.0440 | -0.0983 |
| 2000000. | -70.00 | 225.0000 | 0.4512 | -0.4349 | 0.0612 | -0.1035 |
| 2000000. | -70.00 | 240.0000 | 0.4249 | -0.4048 | 0.0789 | -0.1023 |
| 2000000. | -70.00 | 255.0000 | 0.4003 | -0.3762 | 0.0986 | -0.0947 |
| 2000000. | -70.00 | 270.0000 | 0.3790 | -0.3510 | 0.1191 | -0.0795 |
| 2000000. | -70.00 | 285.0000 | 0.3633 | -0.3320 | 0.1364 | -0.0567 |
| 2000000. | -70.00 | 300.0000 | 0.3543 | -0.3211 | 0.1467 | -0.0302 |
| 2000000. | -70.00 | 315.0000 | 0.3498 | -0.3164 | 0.1491 | -0.0051 |
| 2000000. | -70.00 | 330.0000 | 0.3469 | -0.3146 | 0.1452 | 0.0172 |
| 2000000. | -70.00 | 345.0000 | 0.3464 | -0.3161 | 0.1365 | 0.0380 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 2000000. | -60.00 | 0. | 0.3032 | -0.2713 | 0.1234 | 0.0552 |
| 2000000. | -60.00 | 15.0000 | 0.3146 | -0.2867 | 0.1131 | 0.0635 |
| 2000000. | -60.00 | 30.0000 | 0.3319 | -0.3066 | 0.1051 | 0.0717 |
| 2000000. | -60.00 | 45.0000 | 0.3540 | -0.3318 | 0.0960 | 0.0778 |
| 2000000. | -60.00 | 60.0000 | 0.3768 | -0.3583 | 0.0837 | 0.0814 |
| 2000000. | -60.00 | 75.0000 | 0.4026 | -0.3877 | 0.0699 | 0.0831 |
| 2000000. | -60.00 | 90.0000 | 0.4326 | -0.4215 | 0.0579 | 0.0785 |
| 2000000. | -60.00 | 105.0000 | 0.4630 | -0.4561 | 0.0475 | 0.0639 |
| 2000000. | -60.00 | 120.0000 | 0.4864 | -0.4831 | 0.0405 | 0.0392 |
| 2000000. | -60.00 | 135.0000 | 0.5001 | -0.4983 | 0.0405 | 0.0125 |
| 2000000. | -60.00 | 150.0000 | 0.5084 | -0.5059 | 0.0495 | -0.0113 |
| 2000000. | -60.00 | 165.0000 | 0.5143 | -0.5090 | 0.0636 | -0.0361 |
| 2000000. | -60.00 | 180.0000 | 0.5052 | -0.4946 | 0.0801 | -0.0648 |
| 2000000. | -60.00 | 195.0000 | 0.4797 | -0.4628 | 0.0964 | -0.0817 |
| 2000000. | -60.00 | 210.0000 | 0.4526 | -0.4306 | 0.1095 | -0.0858 |
| 2000000. | -60.00 | 225.0000 | 0.4293 | -0.4039 | 0.1181 | -0.0849 |
| 2000000. | -60.00 | 240.0000 | 0.4075 | -0.3785 | 0.1240 | -0.0861 |
| 2000000. | -60.00 | 255.0000 | 0.3814 | -0.3468 | 0.1335 | -0.0862 |
| 2000000. | -60.00 | 270.0000 | 0.3525 | -0.3112 | 0.1465 | -0.0770 |
| 2000000. | -60.00 | 285.0000 | 0.3266 | -0.2794 | 0.1593 | -0.0563 |
| 2000000. | -60.00 | 300.0000 | 0.3086 | -0.2584 | 0.1665 | -0.0272 |
| 2000000. | -60.00 | 315.0000 | 0.2987 | -0.2498 | 0.1637 | 0.0020 |
| 2000000. | -60.00 | 330.0000 | 0.2944 | -0.2507 | 0.1521 | 0.0256 |
| 2000000. | -60.00 | 345.0000 | 0.2957 | -0.2583 | 0.1373 | 0.0434 |
| 2000000. | -50.00 | 0. | 0.2664 | -0.2334 | 0.1160 | 0.0551 |
| 2000000. | -50.00 | 15.0000 | 0.2608 | -0.2529 | 0.1078 | 0.0572 |
| 2000000. | -50.00 | 30.0000 | 0.2979 | -0.2723 | 0.1052 | 0.0598 |
| 2000000. | -50.00 | 45.0000 | 0.3195 | -0.2946 | 0.1042 | 0.0666 |
| 2000000. | -50.00 | 60.0000 | 0.3478 | -0.3247 | 0.1004 | 0.0737 |
| 2000000. | -50.00 | 75.0000 | 0.3615 | -0.3622 | 0.0924 | 0.0765 |
| 2000000. | -50.00 | 90.0000 | 0.4156 | -0.4009 | 0.0843 | 0.0698 |
| 2000000. | -50.00 | 105.0000 | 0.4499 | -0.4392 | 0.0812 | 0.0547 |
| 2000000. | -50.00 | 120.0000 | 0.4756 | -0.4671 | 0.0850 | 0.0286 |
| 2000000. | -50.00 | 135.0000 | 0.4887 | -0.4796 | 0.0942 | 0.0007 |
| 2000000. | -50.00 | 150.0000 | 0.4870 | -0.4741 | 0.1087 | -0.0254 |
| 2000000. | -50.00 | 165.0000 | 0.4798 | -0.4614 | 0.1240 | -0.0436 |
| 2000000. | -50.00 | 180.0000 | 0.4644 | -0.4399 | 0.1351 | -0.0630 |
| 2000000. | -50.00 | 195.0000 | 0.4390 | -0.4091 | 0.1415 | -0.0729 |
| 2000000. | -50.00 | 210.0000 | 0.4112 | -0.3772 | 0.1455 | -0.0749 |
| 2000000. | -50.00 | 225.0000 | 0.3881 | -0.3503 | 0.1506 | -0.0722 |
| 2000000. | -50.00 | 240.0000 | 0.3707 | -0.3278 | 0.1568 | -0.0734 |
| 2000000. | -50.00 | 255.0000 | 0.3461 | -0.2958 | 0.1627 | -0.0762 |
| 2000000. | -50.00 | 270.0000 | 0.3154 | -0.2568 | 0.1691 | -0.0704 |
| 2000000. | -50.00 | 285.0000 | 0.2840 | -0.2181 | 0.1745 | -0.0514 |
| 2000000. | -50.00 | 300.0000 | 0.2602 | -0.1929 | 0.1736 | -0.0192 |
| 2000000. | -50.00 | 315.0000 | 0.2499 | -0.1886 | 0.1635 | 0.0135 |
| 2000000. | -50.00 | 330.0000 | 0.2501 | -0.1990 | 0.1470 | 0.0367 |
| 2000000. | -50.00 | 345.0000 | 0.2557 | -0.2147 | 0.1296 | 0.0496 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 2000000. | -40.00 | 0. | 0.2437 | -0.2106 | 0.1097 | 0.0546 |
| 2000000. | -40.00 | 15.0000 | 0.2586 | -0.2302 | 0.1072 | 0.0491 |
| 2000000. | -40.00 | 30.0000 | 0.2729 | -0.2449 | 0.1098 | 0.0495 |
| 2000000. | -40.00 | 45.0000 | 0.2944 | -0.2664 | 0.1126 | 0.0550 |
| 2000000. | -40.00 | 60.0000 | 0.3239 | -0.2953 | 0.1169 | 0.0634 |
| 2000000. | -40.00 | 75.0000 | 0.3630 | -0.3363 | 0.1184 | 0.0681 |
| 2000000. | -40.00 | 90.0000 | 0.4029 | -0.3800 | 0.1198 | 0.0601 |
| 2000000. | -40.00 | 105.0000 | 0.4360 | -0.4154 | 0.1258 | 0.0416 |
| 2000000. | -40.00 | 120.0000 | 0.4575 | -0.4365 | 0.1361 | 0.0158 |
| 2000000. | -40.00 | 135.0000 | 0.4648 | -0.4405 | 0.1480 | -0.0093 |
| 2000000. | -40.00 | 150.0000 | 0.4566 | -0.4279 | 0.1562 | -0.0315 |
| 2000000. | -40.00 | 165.0000 | 0.4431 | -0.4087 | 0.1646 | -0.0464 |
| 2000000. | -40.00 | 180.0000 | 0.4234 | -0.3817 | 0.1732 | -0.0602 |
| 2000000. | -40.00 | 195.0000 | 0.3972 | -0.3488 | 0.1786 | -0.0649 |
| 2000000. | -40.00 | 210.0000 | 0.3750 | -0.3227 | 0.1799 | -0.0641 |
| 2000000. | -40.00 | 225.0000 | 0.3539 | -0.2967 | 0.1818 | -0.0648 |
| 2000000. | -40.00 | 240.0000 | 0.3326 | -0.2693 | 0.1839 | -0.0651 |
| 2000000. | -40.00 | 255.0000 | 0.3079 | -0.2378 | 0.1840 | -0.0664 |
| 2000000. | -40.00 | 270.0000 | 0.2776 | -0.1989 | 0.1836 | -0.0614 |
| 2000000. | -40.00 | 285.0000 | 0.2458 | -0.1606 | 0.1811 | -0.0426 |
| 2000000. | -40.00 | 300.0000 | 0.2223 | -0.1375 | 0.1745 | -0.0094 |
| 2000000. | -40.00 | 315.0000 | 0.2149 | -0.1393 | 0.1618 | 0.0243 |
| 2000000. | -40.00 | 330.0000 | 0.2189 | -0.1583 | 0.1435 | 0.0478 |
| 2000000. | -40.00 | 345.0000 | 0.2300 | -0.1858 | 0.1230 | 0.0567 |
| | | | | | | |
| 2000000. | -30.00 | 0. | 0.2363 | -0.1993 | 0.1149 | 0.0541 |
| 2000000. | -30.00 | 15.0000 | 0.2463 | -0.2145 | 0.1138 | 0.0409 |
| 2000000. | -30.00 | 30.0000 | 0.2592 | -0.2267 | 0.1187 | 0.0411 |
| 2000000. | -30.00 | 45.0000 | 0.2799 | -0.2451 | 0.1286 | 0.0419 |
| 2000000. | -30.00 | 60.0000 | 0.3050 | -0.2663 | 0.1398 | 0.0506 |
| 2000000. | -30.00 | 75.0000 | 0.3420 | -0.3019 | 0.1507 | 0.0558 |
| 2000000. | -30.00 | 90.0000 | 0.3801 | -0.3513 | 0.1604 | 0.0475 |
| 2000000. | -30.00 | 105.0000 | 0.4101 | -0.3707 | 0.1730 | 0.0282 |
| 2000000. | -30.00 | 120.0000 | 0.4255 | -0.3813 | 0.1888 | 0.0029 |
| 2000000. | -30.00 | 135.0000 | 0.4252 | -0.3744 | 0.2009 | -0.0156 |
| 2000000. | -30.00 | 150.0000 | 0.4178 | -0.3615 | 0.2069 | -0.0323 |
| 2000000. | -30.00 | 165.0000 | 0.4020 | -0.3384 | 0.2119 | -0.0466 |
| 2000000. | -30.00 | 180.0000 | 0.3797 | -0.3090 | 0.2136 | -0.0553 |
| 2000000. | -30.00 | 195.0000 | 0.3559 | -0.2802 | 0.2116 | -0.0577 |
| 2000000. | -30.00 | 210.0000 | 0.3355 | -0.2535 | 0.2121 | -0.0579 |
| 2000000. | -30.00 | 225.0000 | 0.3145 | -0.2266 | 0.2106 | -0.0569 |
| 2000000. | -30.00 | 240.0000 | 0.2942 | -0.2019 | 0.2066 | -0.0561 |
| 2000000. | -30.00 | 255.0000 | 0.2729 | -0.1741 | 0.2024 | -0.0568 |
| 2000000. | -30.00 | 270.0000 | 0.2473 | -0.1394 | 0.1977 | -0.0516 |
| 2000000. | -30.00 | 285.0000 | 0.2213 | -0.1063 | 0.1913 | -0.0328 |
| 2000000. | -30.00 | 300.0000 | 0.2017 | -0.0892 | 0.1809 | 0.0005 |
| 2000000. | -30.00 | 315.0000 | 0.1957 | -0.0985 | 0.1655 | 0.0345 |
| 2000000. | -30.00 | 330.0000 | 0.2031 | -0.1279 | 0.1469 | 0.0579 |
| 2000000. | -30.00 | 345.0000 | 0.2203 | -0.1674 | 0.1282 | 0.0638 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 2000000. | -20.00 | 0. | 0.2379 | -0.1841 | 0.1404 | 0.0547 |
| 2000000. | -20.00 | 15.0000 | 0.2467 | -0.2012 | 0.1383 | 0.0357 |
| 2000000. | -20.00 | 30.0000 | 0.2565 | -0.2084 | 0.1465 | 0.0302 |
| 2000000. | -20.00 | 45.0000 | 0.2710 | -0.2162 | 0.1607 | 0.0296 |
| 2000000. | -20.00 | 60.0000 | 0.2912 | -0.2304 | 0.1740 | 0.0374 |
| 2000000. | -20.00 | 75.0000 | 0.3200 | -0.2551 | 0.1884 | 0.0428 |
| 2000000. | -20.00 | 90.0000 | 0.3527 | -0.2868 | 0.2024 | 0.0342 |
| 2000000. | -20.00 | 105.0000 | 0.3744 | -0.3026 | 0.2201 | 0.0136 |
| 2000000. | -20.00 | 120.0000 | 0.3807 | -0.2993 | 0.2352 | -0.0064 |
| 2000000. | -20.00 | 135.0000 | 0.3764 | -0.2878 | 0.2419 | -0.0190 |
| 2000000. | -20.00 | 150.0000 | 0.3672 | -0.2725 | 0.2441 | -0.0318 |
| 2000000. | -20.00 | 165.0000 | 0.3510 | -0.2497 | 0.2430 | -0.0432 |
| 2000000. | -20.00 | 180.0000 | 0.3321 | -0.2221 | 0.2416 | -0.0507 |
| 2000000. | -20.00 | 195.0000 | 0.3138 | -0.1956 | 0.2399 | -0.0517 |
| 2000000. | -20.00 | 210.0000 | 0.2944 | -0.1697 | 0.2351 | -0.0510 |
| 2000000. | -20.00 | 225.0000 | 0.2772 | -0.1477 | 0.2295 | -0.0495 |
| 2000000. | -20.00 | 240.0000 | 0.2625 | -0.1276 | 0.2245 | -0.0479 |
| 2000000. | -20.00 | 255.0000 | 0.2475 | -0.1046 | 0.2189 | -0.0487 |
| 2000000. | -20.00 | 270.0000 | 0.2297 | -0.0752 | 0.2127 | -0.0432 |
| 2000000. | -20.00 | 285.0000 | 0.2119 | -0.0472 | 0.2052 | -0.0241 |
| 2000000. | -20.00 | 300.0000 | 0.1979 | -0.0369 | 0.1942 | 0.0099 |
| 2000000. | -20.00 | 315.0000 | 0.1930 | -0.0542 | 0.1800 | 0.0435 |
| 2000000. | -20.00 | 330.0000 | 0.1997 | -0.0925 | 0.1644 | 0.0656 |
| 2000000. | -20.00 | 345.0000 | 0.2179 | -0.1423 | 0.1493 | 0.0702 |
| 2000000. | -10.00 | 0. | 0.2344 | -0.1441 | 0.1772 | 0.0528 |
| 2000000. | -10.00 | 15.0000 | 0.2469 | -0.1642 | 0.1816 | 0.0320 |
| 2000000. | -10.00 | 30.0000 | 0.2536 | -0.1672 | 0.1896 | 0.0202 |
| 2000000. | -10.00 | 45.0000 | 0.2622 | -0.1649 | 0.2031 | 0.0184 |
| 2000000. | -10.00 | 60.0000 | 0.2779 | -0.1715 | 0.2170 | 0.0266 |
| 2000000. | -10.00 | 75.0000 | 0.2991 | -0.1887 | 0.2301 | 0.0311 |
| 2000000. | -10.00 | 90.0000 | 0.3236 | -0.2111 | 0.2443 | 0.0226 |
| 2000000. | -10.00 | 105.0000 | 0.3351 | -0.2145 | 0.2574 | 0.0021 |
| 2000000. | -10.00 | 120.0000 | 0.3345 | -0.2002 | 0.2676 | -0.0124 |
| 2000000. | -10.00 | 135.0000 | 0.3285 | -0.1853 | 0.2706 | -0.0191 |
| 2000000. | -10.00 | 150.0000 | 0.3190 | -0.1716 | 0.2674 | -0.0287 |
| 2000000. | -10.00 | 165.0000 | 0.3061 | -0.1511 | 0.2633 | -0.0397 |
| 2000000. | -10.00 | 180.0000 | 0.2911 | -0.1251 | 0.2589 | -0.0459 |
| 2000000. | -10.00 | 195.0000 | 0.2761 | -0.1014 | 0.2527 | -0.0459 |
| 2000000. | -10.00 | 210.0000 | 0.2633 | -0.0813 | 0.2464 | -0.0447 |
| 2000000. | -10.00 | 225.0000 | 0.2525 | -0.0642 | 0.2404 | -0.0430 |
| 2000000. | -10.00 | 240.0000 | 0.2438 | -0.0481 | 0.2351 | -0.0427 |
| 2000000. | -10.00 | 255.0000 | 0.2369 | -0.0285 | 0.2312 | -0.0429 |
| 2000000. | -10.00 | 270.0000 | 0.2300 | -0.0022 | 0.2269 | -0.0373 |
| 2000000. | -10.00 | 285.0000 | 0.2220 | 0.0225 | 0.2202 | -0.0171 |
| 2000000. | -10.00 | 300.0000 | 0.2126 | 0.0275 | 0.2100 | 0.0179 |
| 2000000. | -10.00 | 315.0000 | 0.2038 | 0.0026 | 0.1973 | 0.0511 |
| 2000000. | -10.00 | 330.0000 | 0.2032 | -0.0436 | 0.1850 | 0.0718 |
| 2000000. | -10.00 | 345.0000 | 0.2166 | -0.1008 | 0.1773 | 0.0729 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 2000000. | 0.00 | 0. | 0.2308 | -0.0799 | 0.2112 | 0.0477 |
| 2000000. | 0.00 | 15.0000 | 0.2418 | -0.0936 | 0.2215 | 0.0262 |
| 2000000. | 0.00 | 30.0000 | 0.2495 | -0.0931 | 0.2311 | 0.0130 |
| 2000000. | 0.00 | 45.0000 | 0.2555 | -0.0848 | 0.2408 | 0.0098 |
| 2000000. | 0.00 | 60.0000 | 0.2677 | -0.0841 | 0.2535 | 0.0170 |
| 2000000. | 0.00 | 75.0000 | 0.2842 | -0.0961 | 0.2665 | 0.0219 |
| 2000000. | 0.00 | 90.0000 | 0.3004 | -0.1111 | 0.2788 | 0.0141 |
| 2000000. | 0.00 | 105.0000 | 0.3065 | -0.1083 | 0.2868 | -0.0035 |
| 2000000. | 0.00 | 120.0000 | 0.3008 | -0.0912 | 0.2863 | -0.0134 |
| 2000000. | 0.00 | 135.0000 | 0.2914 | -0.0775 | 0.2804 | -0.0162 |
| 2000000. | 0.00 | 150.0000 | 0.2818 | -0.0669 | 0.2727 | -0.0239 |
| 2000000. | 0.00 | 165.0000 | 0.2714 | -0.0499 | 0.2644 | -0.0357 |
| 2000000. | 0.00 | 180.0000 | 0.2618 | -0.0264 | 0.2572 | -0.0408 |
| 2000000. | 0.00 | 195.0000 | 0.2555 | -0.0062 | 0.2521 | -0.0415 |
| 2000000. | 0.00 | 210.0000 | 0.2505 | 0.0090 | 0.2471 | -0.0403 |
| 2000000. | 0.00 | 225.0000 | 0.2476 | 0.0216 | 0.2435 | -0.0393 |
| 2000000. | 0.00 | 240.0000 | 0.2480 | 0.0358 | 0.2421 | -0.0403 |
| 2000000. | 0.00 | 255.0000 | 0.2496 | 0.0555 | 0.2400 | -0.0399 |
| 2000000. | 0.00 | 270.0000 | 0.2514 | 0.0813 | 0.2355 | -0.0335 |
| 2000000. | 0.00 | 285.0000 | 0.2512 | 0.1041 | 0.2283 | -0.0106 |
| 2000000. | 0.00 | 300.0000 | 0.2422 | 0.1034 | 0.2176 | 0.0248 |
| 2000000. | 0.00 | 315.0000 | 0.2292 | 0.0725 | 0.2099 | 0.0568 |
| 2000000. | 0.00 | 330.0000 | 0.2193 | 0.0199 | 0.2047 | 0.0760 |
| 2000000. | 0.00 | 345.0000 | 0.2198 | -0.0403 | 0.2039 | 0.0717 |
| 2000000. | 10.00 | 0. | 0.2384 | 0.0056 | 0.2349 | 0.0403 |
| 2000000. | 10.00 | 15.0000 | 0.2461 | 0.0000 | 0.2452 | 0.0202 |
| 2000000. | 10.00 | 30.0000 | 0.2537 | 0.0054 | 0.2536 | 0.0071 |
| 2000000. | 10.00 | 45.0000 | 0.2619 | 0.0149 | 0.2615 | 0.0036 |
| 2000000. | 10.00 | 60.0000 | 0.2729 | 0.0211 | 0.2719 | 0.0085 |
| 2000000. | 10.00 | 75.0000 | 0.2854 | 0.0151 | 0.2847 | 0.0136 |
| 2000000. | 10.00 | 90.0000 | 0.2959 | 0.0070 | 0.2957 | 0.0083 |
| 2000000. | 10.00 | 105.0000 | 0.2967 | 0.0102 | 0.2965 | -0.0037 |
| 2000000. | 10.00 | 120.0000 | 0.2912 | 0.0214 | 0.2903 | -0.0085 |
| 2000000. | 10.00 | 135.0000 | 0.2805 | 0.0276 | 0.2790 | -0.0098 |
| 2000000. | 10.00 | 150.0000 | 0.2681 | 0.0308 | 0.2657 | -0.0170 |
| 2000000. | 10.00 | 165.0000 | 0.2594 | 0.0429 | 0.2541 | -0.0298 |
| 2000000. | 10.00 | 180.0000 | 0.2543 | 0.0611 | 0.2441 | -0.0364 |
| 2000000. | 10.00 | 195.0000 | 0.2538 | 0.0794 | 0.2378 | -0.0394 |
| 2000000. | 10.00 | 210.0000 | 0.2576 | 0.0944 | 0.2364 | -0.0394 |
| 2000000. | 10.00 | 225.0000 | 0.2643 | 0.1083 | 0.2377 | -0.0399 |
| 2000000. | 10.00 | 240.0000 | 0.2726 | 0.1250 | 0.2388 | -0.0405 |
| 2000000. | 10.00 | 255.0000 | 0.2816 | 0.1457 | 0.2378 | -0.0387 |
| 2000000. | 10.00 | 270.0000 | 0.2911 | 0.1713 | 0.2334 | -0.0299 |
| 2000000. | 10.00 | 285.0000 | 0.2941 | 0.1911 | 0.2236 | -0.0037 |
| 2000000. | 10.00 | 300.0000 | 0.2831 | 0.1829 | 0.2138 | 0.0311 |
| 2000000. | 10.00 | 315.0000 | 0.2642 | 0.1496 | 0.2095 | 0.0598 |
| 2000000. | 10.00 | 330.0000 | 0.2452 | 0.0961 | 0.2122 | 0.0766 |
| 2000000. | 10.00 | 345.0000 | 0.2349 | 0.0363 | 0.2220 | 0.0676 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 2000000. | 20.00 | 0. | 0.2628 | 0.1035 | 0.2391 | 0.0343 |
| 2000000. | 20.00 | 15.0000 | 0.2671 | 0.1009 | 0.2467 | 0.0161 |
| 2000000. | 20.00 | 30.0000 | 0.2757 | 0.1093 | 0.2531 | 0.0021 |
| 2000000. | 20.00 | 45.0000 | 0.2867 | 0.1211 | 0.2599 | -0.0021 |
| 2000000. | 20.00 | 60.0000 | 0.2994 | 0.1313 | 0.2691 | 0.0010 |
| 2000000. | 20.00 | 75.0000 | 0.3107 | 0.1335 | 0.2805 | 0.0052 |
| 2000000. | 20.00 | 90.0000 | 0.3176 | 0.1312 | 0.2892 | 0.0048 |
| 2000000. | 20.00 | 105.0000 | 0.3178 | 0.1303 | 0.2899 | -0.0006 |
| 2000000. | 20.00 | 120.0000 | 0.3109 | 0.1335 | 0.2807 | -0.0010 |
| 2000000. | 20.00 | 135.0000 | 0.2955 | 0.1277 | 0.2665 | 0.0001 |
| 2000000. | 20.00 | 150.0000 | 0.2789 | 0.1201 | 0.2516 | -0.0078 |
| 2000000. | 20.00 | 165.0000 | 0.2672 | 0.1228 | 0.2362 | -0.0273 |
| 2000000. | 20.00 | 180.0000 | 0.2655 | 0.1363 | 0.2255 | -0.0325 |
| 2000000. | 20.00 | 195.0000 | 0.2716 | 0.1531 | 0.2208 | -0.0391 |
| 2000000. | 20.00 | 210.0000 | 0.2819 | 0.1710 | 0.2201 | -0.0422 |
| 2000000. | 20.00 | 225.0000 | 0.2965 | 0.1908 | 0.2227 | -0.0436 |
| 2000000. | 20.00 | 240.0000 | 0.3128 | 0.2128 | 0.2252 | -0.0432 |
| 2000000. | 20.00 | 255.0000 | 0.3285 | 0.2369 | 0.2242 | -0.0387 |
| 2000000. | 20.00 | 270.0000 | 0.3402 | 0.2615 | 0.2162 | -0.0245 |
| 2000000. | 20.00 | 285.0000 | 0.3411 | 0.2729 | 0.2045 | 0.0042 |
| 2000000. | 20.00 | 300.0000 | 0.3265 | 0.2580 | 0.1968 | 0.0367 |
| 2000000. | 20.00 | 315.0000 | 0.3029 | 0.2217 | 0.1971 | 0.0612 |
| 2000000. | 20.00 | 330.0000 | 0.2787 | 0.1721 | 0.2069 | 0.0726 |
| 2000000. | 20.00 | 345.0000 | 0.2642 | 0.1251 | 0.2250 | 0.0593 |
| 2000000. | 30.00 | 0. | 0.2980 | 0.1979 | 0.2209 | 0.0294 |
| 2000000. | 30.00 | 15.0000 | 0.3012 | 0.1965 | 0.2279 | 0.0134 |
| 2000000. | 30.00 | 30.0000 | 0.3095 | 0.2050 | 0.2318 | -0.0015 |
| 2000000. | 30.00 | 45.0000 | 0.3229 | 0.2196 | 0.2367 | -0.0077 |
| 2000000. | 30.00 | 60.0000 | 0.3377 | 0.2340 | 0.2433 | -0.0059 |
| 2000000. | 30.00 | 75.0000 | 0.3485 | 0.2410 | 0.2517 | -0.0018 |
| 2000000. | 30.00 | 90.0000 | 0.3561 | 0.2436 | 0.2597 | 0.0008 |
| 2000000. | 30.00 | 105.0000 | 0.3568 | 0.2429 | 0.2614 | 0.0025 |
| 2000000. | 30.00 | 120.0000 | 0.3483 | 0.2373 | 0.2549 | 0.0075 |
| 2000000. | 30.00 | 135.0000 | 0.3310 | 0.2218 | 0.2455 | 0.0100 |
| 2000000. | 30.00 | 150.0000 | 0.3101 | 0.2041 | 0.2335 | 0.0026 |
| 2000000. | 30.00 | 165.0000 | 0.2951 | 0.1956 | 0.2206 | -0.0130 |
| 2000000. | 30.00 | 180.0000 | 0.2913 | 0.2013 | 0.2086 | -0.0291 |
| 2000000. | 30.00 | 195.0000 | 0.3003 | 0.2187 | 0.2019 | -0.0400 |
| 2000000. | 30.00 | 210.0000 | 0.3153 | 0.2396 | 0.1998 | -0.0459 |
| 2000000. | 30.00 | 225.0000 | 0.3360 | 0.2656 | 0.1998 | -0.0493 |
| 2000000. | 30.00 | 240.0000 | 0.3577 | 0.2937 | 0.1988 | -0.0466 |
| 2000000. | 30.00 | 255.0000 | 0.3772 | 0.3210 | 0.1945 | -0.0377 |
| 2000000. | 30.00 | 270.0000 | 0.3881 | 0.3407 | 0.1851 | -0.0178 |
| 2000000. | 30.00 | 285.0000 | 0.3852 | 0.3432 | 0.1746 | 0.0116 |
| 2000000. | 30.00 | 300.0000 | 0.3682 | 0.3234 | 0.1709 | 0.0413 |
| 2000000. | 30.00 | 315.0000 | 0.3423 | 0.2871 | 0.1761 | 0.0610 |
| 2000000. | 30.00 | 330.0000 | 0.3161 | 0.2437 | 0.1907 | 0.0647 |
| 2000000. | 30.00 | 345.0000 | 0.3026 | 0.2123 | 0.2093 | 0.0516 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 2000000. | 40.00 | 0. | 0.3318 | 0.2724 | 0.1875 | 0.0269 |
| 2000000. | 40.00 | 15.0000 | 0.3344 | 0.2727 | 0.1933 | 0.0102 |
| 2000000. | 40.00 | 30.0000 | 0.3436 | 0.2818 | 0.1965 | -0.0038 |
| 2000000. | 40.00 | 45.0000 | 0.3566 | 0.2963 | 0.1981 | -0.0121 |
| 2000000. | 40.00 | 60.0000 | 0.3733 | 0.3136 | 0.2022 | -0.0128 |
| 2000000. | 40.00 | 75.0000 | 0.3872 | 0.3260 | 0.2088 | -0.0088 |
| 2000000. | 40.00 | 90.0000 | 0.3978 | 0.3345 | 0.2151 | -0.0047 |
| 2000000. | 40.00 | 105.0000 | 0.4022 | 0.3373 | 0.2190 | 0.0039 |
| 2000000. | 40.00 | 120.0000 | 0.3931 | 0.3271 | 0.2176 | 0.0135 |
| 2000000. | 40.00 | 135.0000 | 0.3730 | 0.3054 | 0.2134 | 0.0186 |
| 2000000. | 40.00 | 150.0000 | 0.3483 | 0.2793 | 0.2077 | 0.0115 |
| 2000000. | 40.00 | 165.0000 | 0.3319 | 0.2645 | 0.2004 | -0.0053 |
| 2000000. | 40.00 | 180.0000 | 0.3276 | 0.2644 | 0.1917 | -0.0251 |
| 2000000. | 40.00 | 195.0000 | 0.3371 | 0.2800 | 0.1834 | -0.0401 |
| 2000000. | 40.00 | 210.0000 | 0.3544 | 0.3030 | 0.1769 | -0.0496 |
| 2000000. | 40.00 | 225.0000 | 0.3770 | 0.3318 | 0.1710 | -0.0527 |
| 2000000. | 40.00 | 240.0000 | 0.3997 | 0.3614 | 0.1638 | -0.0484 |
| 2000000. | 40.00 | 255.0000 | 0.4188 | 0.3880 | 0.1538 | -0.0347 |
| 2000000. | 40.00 | 270.0000 | 0.4265 | 0.4020 | 0.1423 | -0.0106 |
| 2000000. | 40.00 | 285.0000 | 0.4204 | 0.3976 | 0.1354 | 0.0179 |
| 2000000. | 40.00 | 300.0000 | 0.4006 | 0.3741 | 0.1362 | 0.0443 |
| 2000000. | 40.00 | 315.0000 | 0.3764 | 0.3418 | 0.1468 | 0.0579 |
| 2000000. | 40.00 | 330.0000 | 0.3545 | 0.3093 | 0.1635 | 0.0570 |
| 2000000. | 40.00 | 345.0000 | 0.3405 | 0.2865 | 0.1779 | 0.0469 |
| 2000000. | 50.00 | 0. | 0.3617 | 0.3277 | 0.1513 | 0.0244 |
| 2000000. | 50.00 | 15.0000 | 0.3641 | 0.3287 | 0.1565 | 0.0082 |
| 2000000. | 50.00 | 30.0000 | 0.3718 | 0.3367 | 0.1575 | -0.0054 |
| 2000000. | 50.00 | 45.0000 | 0.3846 | 0.3507 | 0.1571 | -0.0153 |
| 2000000. | 50.00 | 60.0000 | 0.4016 | 0.3694 | 0.1565 | -0.0189 |
| 2000000. | 50.00 | 75.0000 | 0.4178 | 0.3860 | 0.1591 | -0.0161 |
| 2000000. | 50.00 | 90.0000 | 0.4309 | 0.3988 | 0.1628 | -0.0097 |
| 2000000. | 50.00 | 105.0000 | 0.4355 | 0.4032 | 0.1646 | 0.0028 |
| 2000000. | 50.00 | 120.0000 | 0.4290 | 0.3942 | 0.1688 | 0.0146 |
| 2000000. | 50.00 | 135.0000 | 0.4135 | 0.3743 | 0.1745 | 0.0217 |
| 2000000. | 50.00 | 150.0000 | 0.3927 | 0.3495 | 0.1784 | 0.0158 |
| 2000000. | 50.00 | 165.0000 | 0.3776 | 0.3336 | 0.1770 | 0.0005 |
| 2000000. | 50.00 | 180.0000 | 0.3697 | 0.3281 | 0.1694 | -0.0196 |
| 2000000. | 50.00 | 195.0000 | 0.3750 | 0.3379 | 0.1581 | -0.0378 |
| 2000000. | 50.00 | 210.0000 | 0.3903 | 0.3582 | 0.1466 | -0.0501 |
| 2000000. | 50.00 | 225.0000 | 0.4122 | 0.3860 | 0.1344 | -0.0530 |
| 2000000. | 50.00 | 240.0000 | 0.4323 | 0.4126 | 0.1207 | -0.0457 |
| 2000000. | 50.00 | 255.0000 | 0.4453 | 0.4316 | 0.1061 | -0.0274 |
| 2000000. | 50.00 | 270.0000 | 0.4461 | 0.4360 | 0.0944 | -0.0031 |
| 2000000. | 50.00 | 285.0000 | 0.4386 | 0.4285 | 0.0912 | 0.0217 |
| 2000000. | 50.00 | 300.0000 | 0.4226 | 0.4085 | 0.0990 | 0.0436 |
| 2000000. | 50.00 | 315.0000 | 0.4015 | 0.3819 | 0.1116 | 0.0543 |
| 2000000. | 50.00 | 330.0000 | 0.3811 | 0.3559 | 0.1257 | 0.0526 |
| 2000000. | 50.00 | 345.0000 | 0.3672 | 0.3369 | 0.1399 | 0.0419 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 2000000. | 60.00 | 0. | 0.3856 | 0.3672 | 0.1157 | 0.0217 |
| 2000000. | 60.00 | 15.0000 | 0.3878 | 0.3688 | 0.1197 | 0.0074 |
| 2000000. | 60.00 | 30.0000 | 0.3936 | 0.3750 | 0.1195 | -0.0055 |
| 2000000. | 60.00 | 45.0000 | 0.4031 | 0.3857 | 0.1159 | -0.0157 |
| 2000000. | 60.00 | 60.0000 | 0.4161 | 0.4002 | 0.1119 | -0.0223 |
| 2000000. | 60.00 | 75.0000 | 0.4340 | 0.4191 | 0.1100 | -0.0236 |
| 2000000. | 60.00 | 90.0000 | 0.4505 | 0.4364 | 0.1105 | -0.0153 |
| 2000000. | 60.00 | 105.0000 | 0.4568 | 0.4423 | 0.1143 | -0.0019 |
| 2000000. | 60.00 | 120.0000 | 0.4556 | 0.4393 | 0.1204 | 0.0100 |
| 2000000. | 60.00 | 135.0000 | 0.4454 | 0.4263 | 0.1276 | 0.0189 |
| 2000000. | 60.00 | 150.0000 | 0.4287 | 0.4068 | 0.1341 | 0.0157 |
| 2000000. | 60.00 | 165.0000 | 0.4157 | 0.3926 | 0.1368 | 0.0029 |
| 2000000. | 60.00 | 180.0000 | 0.4085 | 0.3853 | 0.1348 | -0.0145 |
| 2000000. | 60.00 | 195.0000 | 0.4105 | 0.3893 | 0.1259 | -0.0327 |
| 2000000. | 60.00 | 210.0000 | 0.4213 | 0.4038 | 0.1114 | -0.0449 |
| 2000000. | 60.00 | 225.0000 | 0.4360 | 0.4233 | 0.0934 | -0.0468 |
| 2000000. | 60.00 | 240.0000 | 0.4492 | 0.4411 | 0.0762 | -0.0377 |
| 2000000. | 60.00 | 255.0000 | 0.4559 | 0.4511 | 0.0629 | -0.0186 |
| 2000000. | 60.00 | 270.0000 | 0.4520 | 0.4485 | 0.0559 | 0.0044 |
| 2000000. | 60.00 | 285.0000 | 0.4426 | 0.4385 | 0.0557 | 0.0236 |
| 2000000. | 60.00 | 300.0000 | 0.4319 | 0.4253 | 0.0630 | 0.0403 |
| 2000000. | 60.00 | 315.0000 | 0.4156 | 0.4053 | 0.0769 | 0.0504 |
| 2000000. | 60.00 | 330.0000 | 0.3988 | 0.3849 | 0.0929 | 0.0478 |
| 2000000. | 60.00 | 345.0000 | 0.3887 | 0.3720 | 0.1066 | 0.0365 |
| 2000000. | 70.00 | 0. | 0.4055 | 0.3963 | 0.0835 | 0.0202 |
| 2000000. | 70.00 | 15.0000 | 0.4066 | 0.3970 | 0.0871 | 0.0079 |
| 2000000. | 70.00 | 30.0000 | 0.4097 | 0.4003 | 0.0869 | -0.0035 |
| 2000000. | 70.00 | 45.0000 | 0.4152 | 0.4064 | 0.0837 | -0.0141 |
| 2000000. | 70.00 | 60.0000 | 0.4247 | 0.4169 | 0.0780 | -0.0229 |
| 2000000. | 70.00 | 75.0000 | 0.4387 | 0.4322 | 0.0709 | -0.0264 |
| 2000000. | 70.00 | 90.0000 | 0.4533 | 0.4480 | 0.0653 | -0.0217 |
| 2000000. | 70.00 | 105.0000 | 0.4635 | 0.4588 | 0.0645 | -0.0108 |
| 2000000. | 70.00 | 120.0000 | 0.4665 | 0.4614 | 0.0684 | 0.0017 |
| 2000000. | 70.00 | 135.0000 | 0.4612 | 0.4547 | 0.0765 | 0.0107 |
| 2000000. | 70.00 | 150.0000 | 0.4510 | 0.4427 | 0.0855 | 0.0102 |
| 2000000. | 70.00 | 165.0000 | 0.4422 | 0.4329 | 0.0905 | 0.0009 |
| 2000000. | 70.00 | 180.0000 | 0.4378 | 0.4283 | 0.0895 | -0.0122 |
| 2000000. | 70.00 | 195.0000 | 0.4376 | 0.4292 | 0.0816 | -0.0248 |
| 2000000. | 70.00 | 210.0000 | 0.4411 | 0.4345 | 0.0682 | -0.0330 |
| 2000000. | 70.00 | 225.0000 | 0.4468 | 0.4425 | 0.05[illegible]1 | -0.0340 |
| 2000000. | 70.00 | 240.0000 | 0.4529 | 0.4507 | 0.0370 | -0.0264 |
| 2000000. | 70.00 | 255.0000 | 0.4561 | 0.4552 | 0.0266 | -0.0107 |
| 2000000. | 70.00 | 270.0000 | 0.4533 | 0.4526 | 0.0234 | 0.0086 |
| 2000000. | 70.00 | 285.0000 | 0.4454 | 0.4438 | 0.0270 | 0.0256 |
| 2000000. | 70.00 | 300.0000 | 0.4350 | 0.4319 | 0.0357 | 0.0379 |
| 2000000. | 70.00 | 315.0000 | 0.4236 | 0.4185 | 0.0488 | 0.0437 |
| 2000000. | 70.00 | 330.0000 | 0.4136 | 0.4067 | 0.0632 | 0.0410 |
| 2000000. | 70.00 | 345.0000 | 0.4075 | 0.3992 | 0.0754 | 0.0320 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 2000000. | 80.00 | 0. | 0.4237 | 0.4200 | 0.0530 | 0.0181 |
| 2000000. | 80.00 | 15.0000 | 0.4245 | 0.4207 | 0.0567 | 0.0082 |
| 2000000. | 80.00 | 30.0000 | 0.4268 | 0.4229 | 0.0572 | -0.0018 |
| 2000000. | 80.00 | 45.0000 | 0.4303 | 0.4267 | 0.0545 | -0.0109 |
| 2000000. | 80.00 | 60.0000 | 0.4353 | 0.4321 | 0.0490 | -0.0180 |
| 2000000. | 80.00 | 75.0000 | 0.4413 | 0.4388 | 0.0417 | -0.0216 |
| 2000000. | 80.00 | 90.0000 | 0.4476 | 0.4458 | 0.0345 | -0.0210 |
| 2000000. | 80.00 | 105.0000 | 0.4529 | 0.4516 | 0.0294 | -0.0166 |
| 2000000. | 80.00 | 120.0000 | 0.4560 | 0.4550 | 0.0276 | -0.0105 |
| 2000000. | 80.00 | 135.0000 | 0.4566 | 0.4556 | 0.0297 | -0.0055 |
| 2000000. | 80.00 | 150.0000 | 0.4550 | 0.4538 | 0.0331 | -0.0039 |
| 2000000. | 80.00 | 165.0000 | 0.4526 | 0.4511 | 0.0356 | -0.0061 |
| 2000000. | 80.00 | 180.0000 | 0.4502 | 0.4487 | 0.0350 | -0.0106 |
| 2000000. | 80.00 | 195.0000 | 0.4485 | 0.4472 | 0.0307 | -0.0153 |
| 2000000. | 80.00 | 210.0000 | 0.4478 | 0.4468 | 0.0232 | -0.0179 |
| 2000000. | 80.00 | 225.0000 | 0.4477 | 0.4472 | 0.0140 | -0.0165 |
| 2000000. | 80.00 | 240.0000 | 0.4478 | 0.4476 | 0.0055 | -0.0104 |
| 2000000. | 80.00 | 255.0000 | 0.4470 | 0.4470 | 0.0001 | -0.0003 |
| 2000000. | 80.00 | 270.0000 | 0.4448 | 0.4446 | -0.0005 | 0.0118 |
| 2000000. | 80.00 | 285.0000 | 0.4410 | 0.4403 | 0.0041 | 0.0232 |
| 2000000. | 80.00 | 300.0000 | 0.4361 | 0.4348 | 0.0131 | 0.0313 |
| 2000000. | 80.00 | 315.0000 | 0.4311 | 0.4290 | 0.0245 | 0.0346 |
| 2000000. | 80.00 | 330.0000 | 0.4270 | 0.4242 | 0.0361 | 0.0328 |
| 2000000. | 80.00 | 345.0000 | 0.4245 | 0.4211 | 0.0460 | 0.0268 |
| 2000000. | 90.00 | 0. | 0.4422 | 0.4417 | 0 | 0 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 3000000. | -90.00 | 0. | 0.3824 | -0.3721 | 0 | 0 |
| 3000000. | -80.00 | 0. | 0.3504 | -0.3346 | 0.0908 | 0.0506 |
| 3000000. | -80.00 | 15.0000 | 0.3551 | -0.3407 | 0.0765 | 0.0642 |
| 3000000. | -80.00 | 30.0000 | 0.3609 | -0.3482 | 0.0596 | 0.0758 |
| 3000000. | -80.00 | 45.0000 | 0.3675 | -0.3564 | 0.0413 | 0.0793 |
| 3000000. | -80.00 | 60.0000 | 0.3748 | -0.3653 | 0.0222 | 0.0808 |
| 3000000. | -80.00 | 75.0000 | 0.3828 | -0.3748 | 0.0029 | 0.0780 |
| 3000000. | -80.00 | 90.0000 | 0.3915 | -0.3848 | -0.0158 | 0.0704 |
| 3000000. | -80.00 | 105.0000 | 0.4001 | -0.3946 | -0.0323 | 0.0577 |
| 3000000. | -80.00 | 120.0000 | 0.4080 | -0.4035 | -0.0450 | 0.0403 |
| 3000000. | -80.00 | 135.0000 | 0.4145 | -0.4106 | -0.0530 | 0.0194 |
| 3000000. | -80.00 | 150.0000 | 0.4190 | -0.4153 | -0.0557 | -0.0038 |
| 3000000. | -80.00 | 165.0000 | 0.4207 | -0.4165 | -0.0524 | -0.0283 |
| 3000000. | -80.00 | 180.0000 | 0.4187 | -0.4133 | -0.0427 | -0.0520 |
| 3000000. | -80.00 | 195.0000 | 0.4126 | -0.4054 | -0.0266 | -0.0721 |
| 3000000. | -80.00 | 210.0000 | 0.4031 | -0.3937 | -0.0057 | -0.0860 |
| 3000000. | -80.00 | 225.0000 | 0.3915 | -0.3800 | 0.0178 | -0.0923 |
| 3000000. | -80.00 | 240.0000 | 0.3795 | -0.3661 | 0.0416 | -0.0908 |
| 3000000. | -80.00 | 255.0000 | 0.3686 | -0.3536 | 0.0638 | -0.0823 |
| 3000000. | -80.00 | 270.0000 | 0.3597 | -0.3433 | 0.0827 | -0.0681 |
| 3000000. | -80.00 | 285.0000 | 0.3531 | -0.3358 | 0.0971 | -0.0497 |
| 3000000. | -80.00 | 300.0000 | 0.3488 | -0.3310 | 0.1062 | -0.0288 |
| 3000000. | -80.00 | 315.0000 | 0.3466 | -0.3286 | 0.1097 | -0.0073 |
| 3000000. | -80.00 | 330.0000 | 0.3461 | -0.3285 | 0.1081 | 0.0138 |
| 3000000. | -80.00 | 345.0000 | 0.3474 | -0.3305 | 0.1016 | 0.0334 |
| 3000000. | -70.00 | 0. | 0.3121 | -0.2891 | 0.1067 | 0.0493 |
| 3000000. | -70.00 | 15.0000 | 0.3209 | -0.3005 | 0.0945 | 0.0611 |
| 3000000. | -70.00 | 30.0000 | 0.3326 | -0.3151 | 0.0810 | 0.0691 |
| 3000000. | -70.00 | 45.0000 | 0.3453 | -0.3308 | 0.0664 | 0.0735 |
| 3000000. | -70.00 | 60.0000 | 0.3588 | -0.3470 | 0.0508 | 0.0756 |
| 3000000. | -70.00 | 75.0000 | 0.3746 | -0.3653 | 0.0344 | 0.0751 |
| 3000000. | -70.00 | 90.0000 | 0.3927 | -0.3861 | 0.0178 | 0.0693 |
| 3000000. | -70.00 | 105.0000 | 0.4099 | -0.4061 | 0.0033 | 0.0560 |
| 3000000. | -70.00 | 120.0000 | 0.4232 | -0.4215 | -0.0062 | 0.0369 |
| 3000000. | -70.00 | 135.0000 | 0.4324 | -0.4320 | -0.0096 | 0.0162 |
| 3000000. | -70.00 | 150.0000 | 0.4398 | -0.4397 | -0.0081 | -0.0048 |
| 3000000. | -70.00 | 165.0000 | 0.4444 | -0.4435 | -0.0022 | -0.0279 |
| 3000000. | -70.00 | 180.0000 | 0.4420 | -0.4389 | 0.0091 | -0.0519 |
| 3000000. | -70.00 | 195.0000 | 0.4308 | -0.4242 | 0.0246 | -0.0711 |
| 3000000. | -70.00 | 210.0000 | 0.4136 | -0.4032 | 0.0411 | -0.0823 |
| 3000000. | -70.00 | 225.0000 | 0.3937 | -0.3798 | 0.0569 | -0.0866 |
| 3000000. | -70.00 | 240.0000 | 0.3731 | -0.3558 | 0.0727 | -0.0856 |
| 3000000. | -70.00 | 255.0000 | 0.3534 | -0.3326 | 0.0894 | -0.0792 |
| 3000000. | -70.00 | 270.0000 | 0.3360 | -0.3118 | 0.1060 | -0.0665 |
| 3000000. | -70.00 | 285.0000 | 0.3226 | -0.2957 | 0.1197 | -0.047[illegible] |
| 3000000. | -70.00 | 300.0000 | 0.3139 | -0.2855 | 0.1279 | -0.0256 |
| 3000000. | -70.00 | 315.0000 | 0.3090 | -0.2805 | 0.1294 | -0.0035 |
| 3000000. | -70.00 | 330.0000 | 0.3067 | -0.2794 | 0.1254 | 0.0165 |
| 3000000. | -70.00 | 345.0000 | 0.3074 | -0.2820 | 0.1173 | 0.0343 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 3000000. | -60.00 | 0. | 0.2719 | -0.2446 | 0.1083 | 0.0485 |
| 3000000. | -60.00 | 15.0000 | 0.2824 | -0.2587 | 0.0988 | 0.0557 |
| 3000000. | -60.00 | 30.0000 | 0.2972 | -0.2761 | 0.0911 | 0.0619 |
| 3000000. | -60.00 | 45.0000 | 0.3153 | -0.2968 | 0.0829 | 0.0668 |
| 3000000. | -60.00 | 60.0000 | 0.3353 | -0.3197 | 0.0727 | 0.0699 |
| 3000000. | -60.00 | 75.0000 | 0.3576 | -0.3453 | 0.0613 | 0.0702 |
| 3000000. | -60.00 | 90.0000 | 0.3824 | -0.3734 | 0.0505 | 0.0651 |
| 3000000. | -60.00 | 105.0000 | 0.4067 | -0.4012 | 0.0415 | 0.0520 |
| 3000000. | -60.00 | 120.0000 | 0.4255 | -0.4228 | 0.0363 | 0.0315 |
| 3000000. | -60.00 | 135.0000 | 0.4368 | -0.4351 | 0.0371 | 0.0089 |
| 3000000. | -60.00 | 150.0000 | 0.4429 | -0.4405 | 0.0443 | -0.0121 |
| 3000000. | -60.00 | 165.0000 | 0.4446 | -0.4399 | 0.0556 | -0.0333 |
| 3000000. | -60.00 | 180.0000 | 0.4363 | -0.4273 | 0.0687 | -0.0548 |
| 3000000. | -60.00 | 195.0000 | 0.4172 | -0.4033 | 0.0820 | -0.0687 |
| 3000000. | -60.00 | 210.0000 | 0.3953 | -0.3771 | 0.0933 | -0.0734 |
| 3000000. | -60.00 | 225.0000 | 0.3751 | -0.3534 | 0.1020 | -0.0738 |
| 3000000. | -60.00 | 240.0000 | 0.3556 | -0.3302 | 0.1093 | -0.0741 |
| 3000000. | -60.00 | 255.0000 | 0.3336 | -0.3034 | 0.1185 | -0.0725 |
| 3000000. | -60.00 | 270.0000 | 0.3102 | -0.2745 | 0.1296 | -0.0638 |
| 3000000. | -60.00 | 285.0000 | 0.2891 | -0.2489 | 0.1397 | -0.0461 |
| 3000000. | -60.00 | 300.0000 | 0.2741 | -0.2318 | 0.1447 | -0.0219 |
| 3000000. | -60.00 | 315.0000 | 0.2660 | -0.2250 | 0.1418 | 0.0028 |
| 3000000. | -60.00 | 330.0000 | 0.2632 | -0.2263 | 0.1324 | 0.0231 |
| 3000000. | -60.00 | 345.0000 | 0.2652 | -0.2333 | 0.1201 | 0.0383 |
| 3000000. | -50.00 | 0. | 0.2403 | -0.2111 | 0.1041 | 0.0484 |
| 3000000. | -50.00 | 15.0000 | 0.2529 | -0.2281 | 0.0970 | 0.0502 |
| 3000000. | -50.00 | 30.0000 | 0.2679 | -0.2452 | 0.0943 | 0.0527 |
| 3000000. | -50.00 | 45.0000 | 0.2870 | -0.2654 | 0.0926 | 0.0577 |
| 3000000. | -50.00 | 60.0000 | 0.3110 | -0.2912 | 0.0890 | 0.0629 |
| 3000000. | -50.00 | 75.0000 | 0.3391 | -0.3226 | 0.0827 | 0.0642 |
| 3000000. | -50.00 | 90.0000 | 0.3680 | -0.3552 | 0.0766 | 0.0583 |
| 3000000. | -50.00 | 105.0000 | 0.3955 | -0.3860 | 0.0741 | 0.0444 |
| 3000000. | -50.00 | 120.0000 | 0.4161 | -0.4083 | 0.0767 | 0.0231 |
| 3000000. | -50.00 | 135.0000 | 0.4264 | -0.4181 | 0.0838 | -0.0003 |
| 3000000. | -50.00 | 150.0000 | 0.4258 | -0.4146 | 0.0947 | -0.0216 |
| 3000000. | -50.00 | 165.0000 | 0.4192 | -0.4037 | 0.1065 | -0.0384 |
| 3000000. | -50.00 | 180.0000 | 0.4059 | -0.3852 | 0.1162 | -0.0539 |
| 3000000. | -50.00 | 195.0000 | 0.3848 | -0.3591 | 0.1232 | -0.0626 |
| 3000000. | -50.00 | 210.0000 | 0.3620 | -0.3323 | 0.1281 | -0.0647 |
| 3000000. | -50.00 | 225.0000 | 0.3420 | -0.3086 | 0.1329 | -0.0637 |
| 3000000. | -50.00 | 240.0000 | 0.3247 | -0.2868 | 0.1380 | -0.0641 |
| 3000000. | -50.00 | 255.0000 | 0.3032 | -0.2593 | 0.1433 | -0.0647 |
| 3000000. | -50.00 | 270.0000 | 0.2777 | -0.2270 | 0.1490 | -0.0584 |
| 3000000. | -50.00 | 285.0000 | 0.2525 | -0.1961 | 0.1535 | -0.0416 |
| 3000000. | -50.00 | 300.0000 | 0.2335 | -0.1761 | 0.1527 | -0.0152 |
| 3000000. | -50.00 | 315.0000 | 0.2251 | -0.1723 | 0.1443 | 0.0120 |
| 3000000. | -50.00 | 330.0000 | 0.2252 | -0.1806 | 0.1306 | 0.0319 |
| 3000000. | -50.00 | 345.0000 | 0.2307 | -0.1947 | 0.1158 | 0.0435 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 3000000. | -40.00 | 0. | 0.2196 | -0.1890 | 0.1012 | 0.0479 |
| 3000000. | -40.00 | 15.0000 | 0.2327 | -0.2064 | 0.0982 | 0.0439 |
| 3000000. | -40.00 | 30.0000 | 0.2462 | -0.2208 | 0.0996 | 0.0440 |
| 3000000. | -40.00 | 45.0000 | 0.2648 | -0.2395 | 0.1021 | 0.0480 |
| 3000000. | -40.00 | 60.0000 | 0.2897 | -0.2644 | 0.1054 | 0.0540 |
| 3000000. | -40.00 | 75.0000 | 0.3215 | -0.2979 | 0.1067 | 0.0569 |
| 3000000. | -40.00 | 90.0000 | 0.3541 | -0.3335 | 0.1079 | 0.0499 |
| 3000000. | -40.00 | 105.0000 | 0.3814 | -0.3628 | 0.1125 | 0.0343 |
| 3000000. | -40.00 | 120.0000 | 0.3989 | -0.3800 | 0.1207 | 0.0129 |
| 3000000. | -40.00 | 135.0000 | 0.4047 | -0.3831 | 0.1301 | -0.0082 |
| 3000000. | -40.00 | 150.0000 | 0.3989 | -0.3734 | 0.1377 | -0.0266 |
| 3000000. | -40.00 | 165.0000 | 0.3873 | -0.3568 | 0.1451 | -0.0403 |
| 3000000. | -40.00 | 180.0000 | 0.3705 | -0.3338 | 0.1521 | -0.0516 |
| 3000000. | -40.00 | 195.0000 | 0.3489 | -0.3068 | 0.1565 | -0.0561 |
| 3000000. | -40.00 | 210.0000 | 0.3292 | -0.2829 | 0.1585 | -0.0566 |
| 3000000. | -40.00 | 225.0000 | 0.3104 | -0.2596 | 0.1603 | -0.0568 |
| 3000000. | -40.00 | 240.0000 | 0.2915 | -0.2355 | 0.1621 | -0.0568 |
| 3000000. | -40.00 | 255.0000 | 0.2700 | -0.2080 | 0.1626 | -0.0567 |
| 3000000. | -40.00 | 270.0000 | 0.2450 | -0.1757 | 0.1628 | -0.0512 |
| 3000000. | -40.00 | 285.0000 | 0.2194 | -0.1448 | 0.1612 | -0.0346 |
| 3000000. | -40.00 | 300.0000 | 0.2008 | -0.1266 | 0.1557 | -0.0070 |
| 3000000. | -40.00 | 315.0000 | 0.1945 | -0.1281 | 0.1448 | 0.0210 |
| 3000000. | -40.00 | 330.0000 | 0.1980 | -0.1442 | 0.1293 | 0.0409 |
| 3000000. | -40.00 | 345.0000 | 0.2076 | -0.1675 | 0.1127 | 0.0491 |
| 3000000. | -30.00 | 0. | 0.2107 | -0.1749 | 0.1074 | 0.0475 |
| 3000000. | -30.00 | 15.0000 | 0.2207 | -0.1900 | 0.1058 | 0.0375 |
| 3000000. | -30.00 | 30.0000 | 0.2327 | -0.2018 | 0.1100 | 0.0362 |
| 3000000. | -30.00 | 45.0000 | 0.2500 | -0.2173 | 0.1178 | 0.0373 |
| 3000000. | -30.00 | 60.0000 | 0.2719 | -0.2366 | 0.1268 | 0.0434 |
| 3000000. | -30.00 | 75.0000 | 0.3022 | -0.2661 | 0.1352 | 0.0468 |
| 3000000. | -30.00 | 90.0000 | 0.3333 | -0.2983 | 0.1431 | 0.0396 |
| 3000000. | -30.00 | 105.0000 | 0.3575 | -0.3221 | 0.1533 | 0.0233 |
| 3000000. | -30.00 | 120.0000 | 0.3700 | -0.3309 | 0.1654 | 0.0029 |
| 3000000. | -30.00 | 135.0000 | 0.3704 | -0.3262 | 0.1750 | -0.0134 |
| 3000000. | -30.00 | 150.0000 | 0.3638 | -0.3148 | 0.1803 | -0.0278 |
| 3000000. | -30.00 | 165.0000 | 0.3505 | -0.2954 | 0.1843 | -0.0400 |
| 3000000. | -30.00 | 180.0000 | 0.3320 | -0.2706 | 0.1863 | -0.0479 |
| 3000000. | -30.00 | 195.0000 | 0.3119 | -0.2459 | 0.1858 | -0.0506 |
| 3000000. | -30.00 | 210.0000 | 0.2936 | -0.2216 | 0.1858 | -0.0508 |
| 3000000. | -30.00 | 225.0000 | 0.2757 | -0.1984 | 0.1847 | -0.0502 |
| 3000000. | -30.00 | 240.0000 | 0.2582 | -0.1764 | 0.1820 | -0.0493 |
| 3000000. | -30.00 | 255.0000 | 0.2398 | -0.1518 | 0.1790 | -0.0490 |
| 3000000. | -30.00 | 270.0000 | 0.2184 | -0.1224 | 0.1756 | -0.0435 |
| 3000000. | -30.00 | 285.0000 | 0.1972 | -0.0952 | 0.1705 | -0.0267 |
| 3000000. | -30.00 | 300.0000 | 0.1814 | -0.0816 | 0.1620 | 0.0011 |
| 3000000. | -30.00 | 315.0000 | 0.1765 | -0.0894 | 0.1492 | 0.0295 |
| 3000000. | -30.00 | 330.0000 | 0.1825 | -0.1142 | 0.1336 | 0.0492 |
| 3000000. | -30.00 | 345.0000 | 0.1965 | -0.1472 | 0.1181 | 0.0547 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 3000000. | -20.00 | 0. | 0.2080 | -0.1567 | 0.1282 | 0.0476 |
| 3000000. | -20.00 | 15.0000 | 0.2174 | -0.1731 | 0.1273 | 0.0329 |
| 3000000. | -20.00 | 30.0000 | 0.2266 | -0.1808 | 0.1339 | 0.0274 |
| 3000000. | -20.00 | 45.0000 | 0.2395 | -0.1887 | 0.1451 | 0.0270 |
| 3000000. | -20.00 | 60.0000 | 0.2570 | -0.2014 | 0.1562 | 0.0326 |
| 3000000. | -20.00 | 75.0000 | 0.2813 | -0.2229 | 0.1678 | 0.0361 |
| 3000000. | -20.00 | 90.0000 | 0.3078 | -0.2485 | 0.1792 | 0.0288 |
| 3000000. | -20.00 | 105.0000 | 0.3257 | -0.2621 | 0.1929 | 0.0120 |
| 3000000. | -20.00 | 120.0000 | 0.3315 | -0.2606 | 0.2049 | -0.0047 |
| 3000000. | -20.00 | 135.0000 | 0.3283 | -0.2512 | 0.2107 | -0.0162 |
| 3000000. | -20.00 | 150.0000 | 0.3204 | -0.2381 | 0.2126 | -0.0274 |
| 3000000. | -20.00 | 165.0000 | 0.3068 | -0.2185 | 0.2121 | -0.0376 |
| 3000000. | -20.00 | 180.0000 | 0.2906 | -0.1949 | 0.2110 | -0.0439 |
| 3000000. | -20.00 | 195.0000 | 0.2744 | -0.1715 | 0.2093 | -0.0455 |
| 3000000. | -20.00 | 210.0000 | 0.2583 | -0.1493 | 0.2058 | -0.0452 |
| 3000000. | -20.00 | 225.0000 | 0.2434 | -0.1293 | 0.2014 | -0.0439 |
| 3000000. | -20.00 | 240.0000 | 0.2304 | -0.1108 | 0.1975 | -0.0428 |
| 3000000. | -20.00 | 255.0000 | 0.2172 | -0.0900 | 0.1931 | -0.0424 |
| 3000000. | -20.00 | 270.0000 | 0.2024 | -0.0647 | 0.1883 | -0.0366 |
| 3000000. | -20.00 | 285.0000 | 0.1879 | -0.0415 | 0.1822 | -0.0196 |
| 3000000. | -20.00 | 300.0000 | 0.1764 | -0.0335 | 0.1730 | 0.0088 |
| 3000000. | -20.00 | 315.0000 | 0.1721 | -0.0481 | 0.1610 | 0.0371 |
| 3000000. | -20.00 | 330.0000 | 0.1773 | -0.0804 | 0.1478 | 0.0557 |
| 3000000. | -20.00 | 345.0000 | 0.1918 | -0.1220 | 0.1355 | 0.0595 |
| 3000000. | -10.00 | 0. | 0.2037 | -0.1201 | 0.1579 | 0.0460 |
| 3000000. | -10.00 | 15.0000 | 0.2141 | -0.1375 | 0.1615 | 0.0293 |
| 3000000. | -10.00 | 30.0000 | 0.2211 | -0.1417 | 0.1686 | 0.0194 |
| 3000000. | -10.00 | 45.0000 | 0.2293 | -0.1415 | 0.1796 | 0.0177 |
| 3000000. | -10.00 | 60.0000 | 0.2430 | -0.1479 | 0.1913 | 0.0234 |
| 3000000. | -10.00 | 75.0000 | 0.2614 | -0.1629 | 0.2027 | 0.0265 |
| 3000000. | -10.00 | 90.0000 | 0.2812 | -0.1810 | 0.2144 | 0.0193 |
| 3000000. | -10.00 | 105.0000 | 0.2914 | -0.1850 | 0.2251 | 0.0030 |
| 3000000. | -10.00 | 120.0000 | 0.2915 | -0.1750 | 0.2330 | -0.0095 |
| 3000000. | -10.00 | 135.0000 | 0.2866 | -0.1630 | 0.2352 | -0.0164 |
| 3000000. | -10.00 | 150.0000 | 0.2784 | -0.1508 | 0.2327 | -0.0250 |
| 3000000. | -10.00 | 165.0000 | 0.2674 | -0.1331 | 0.2293 | -0.0345 |
| 3000000. | -10.00 | 180.0000 | 0.2545 | -0.1109 | 0.2256 | -0.0400 |
| 3000000. | -10.00 | 195.0000 | 0.2419 | -0.0900 | 0.2208 | -0.0407 |
| 3000000. | -10.00 | 210.0000 | 0.2310 | -0.0718 | 0.2159 | -0.0399 |
| 3000000. | -10.00 | 225.0000 | 0.2219 | -0.0560 | 0.2112 | -0.0388 |
| 3000000. | -10.00 | 240.0000 | 0.2144 | -0.0407 | 0.2071 | -0.0382 |
| 3000000. | -10.00 | 255.0000 | 0.2085 | -0.0225 | 0.2038 | -0.0376 |
| 3000000. | -10.00 | 270.0000 | 0.2023 | 0.0003 | 0.1998 | -0.0316 |
| 3000000. | -10.00 | 285.0000 | 0.1954 | 0.0205 | 0.1938 | -0.0137 |
| 3000000. | -10.00 | 300.0000 | 0.1873 | 0.0241 | 0.1851 | 0.0155 |
| 3000000. | -10.00 | 315.0000 | 0.1800 | 0.0033 | 0.1747 | 0.0434 |
| 3000000. | -10.00 | 330.0000 | 0.1792 | -0.0362 | 0.1647 | 0.0608 |
| 3000000. | -10.00 | 345.0000 | 0.1893 | -0.0835 | 0.1583 | 0.0616 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 3000000. | 0.00 | 0. | 0.2004 | -0.0634 | 0.1854 | 0.0420 |
| 3000000. | 0.00 | 15.0000 | 0.2095 | -0.0764 | 0.1936 | 0.0242 |
| 3000000. | 0.00 | 30.0000 | 0.2162 | -0.0770 | 0.2016 | 0.0131 |
| 3000000. | 0.00 | 45.0000 | 0.2225 | -0.0719 | 0.2103 | 0.0104 |
| 3000000. | 0.00 | 60.0000 | 0.2330 | -0.0723 | 0.2210 | 0.0154 |
| 3000000. | 0.00 | 75.0000 | 0.2469 | -0.0822 | 0.2321 | 0.0187 |
| 3000000. | 0.00 | 90.0000 | 0.2603 | -0.0941 | 0.2424 | 0.0122 |
| 3000000. | 0.00 | 105.0000 | 0.2657 | -0.0929 | 0.2490 | -0.0016 |
| 3000000. | 0.00 | 120.0000 | 0.2622 | -0.0805 | 0.2493 | -0.0103 |
| 3000000. | 0.00 | 135.0000 | 0.2550 | -0.0695 | 0.2450 | -0.0141 |
| 3000000. | 0.00 | 150.0000 | 0.2469 | -0.0603 | 0.2385 | -0.0210 |
| 3000000. | 0.00 | 165.0000 | 0.2380 | -0.0455 | 0.2316 | -0.0308 |
| 3000000. | 0.00 | 180.0000 | 0.2297 | -0.0257 | 0.2254 | -0.0359 |
| 3000000. | 0.00 | 195.0000 | 0.2241 | -0.0076 | 0.2208 | -0.0370 |
| 3000000. | 0.00 | 210.0000 | 0.2199 | 0.0071 | 0.2168 | -0.0364 |
| 3000000. | 0.00 | 225.0000 | 0.2177 | 0.0198 | 0.2138 | -0.0357 |
| 3000000. | 0.00 | 240.0000 | 0.2179 | 0.0335 | 0.2122 | -0.0360 |
| 3000000. | 0.00 | 255.0000 | 0.2190 | 0.0513 | 0.2100 | -0.0348 |
| 3000000. | 0.00 | 270.0000 | 0.2205 | 0.0732 | 0.2061 | -0.0281 |
| 3000000. | 0.00 | 285.0000 | 0.2198 | 0.0915 | 0.1997 | -0.0083 |
| 3000000. | 0.00 | 300.0000 | 0.2122 | 0.0901 | 0.1910 | 0.0213 |
| 3000000. | 0.00 | 315.0000 | 0.2010 | 0.0643 | 0.1843 | 0.0481 |
| 3000000. | 0.00 | 330.0000 | 0.1921 | 0.0202 | 0.1800 | 0.0639 |
| 3000000. | 0.00 | 345.0000 | 0.1921 | -0.0297 | 0.1798 | 0.0608 |
| 3000000. | 10.00 | 0. | 0.2077 | 0.0103 | 0.2042 | 0.0364 |
| 3000000. | 10.00 | 15.0000 | 0.2136 | 0.0036 | 0.2127 | 0.0192 |
| 3000000. | 10.00 | 30.0000 | 0.2203 | 0.0067 | 0.2200 | 0.0081 |
| 3000000. | 10.00 | 45.0000 | 0.2276 | 0.0140 | 0.2271 | 0.0048 |
| 3000000. | 10.00 | 60.0000 | 0.2370 | 0.0182 | 0.2362 | 0.0082 |
| 3000000. | 10.00 | 75.0000 | 0.2476 | 0.0136 | 0.2469 | 0.0116 |
| 3000000. | 10.00 | 90.0000 | 0.2561 | 0.0072 | 0.2559 | 0.0074 |
| 3000000. | 10.00 | 105.0000 | 0.2578 | 0.0091 | 0.2576 | -0.0021 |
| 3000000. | 10.00 | 120.0000 | 0.2536 | 0.0173 | 0.2529 | -0.0068 |
| 3000000. | 10.00 | 135.0000 | 0.2452 | 0.0224 | 0.2440 | -0.0089 |
| 3000000. | 10.00 | 150.0000 | 0.2354 | 0.0258 | 0.2334 | -0.0155 |
| 3000000. | 10.00 | 165.0000 | 0.2280 | 0.0360 | 0.2236 | -0.0259 |
| 3000000. | 10.00 | 180.0000 | 0.2239 | 0.0518 | 0.2154 | -0.0322 |
| 3000000. | 10.00 | 195.0000 | 0.2235 | 0.0679 | 0.2101 | -0.0351 |
| 3000000. | 10.00 | 210.0000 | 0.2267 | 0.0821 | 0.2084 | -0.0355 |
| 3000000. | 10.00 | 225.0000 | 0.2323 | 0.0955 | 0.2087 | -0.0359 |
| 3000000. | 10.00 | 240.0000 | 0.2394 | 0.1112 | 0.2090 | -0.0359 |
| 3000000. | 10.00 | 255.0000 | 0.2472 | 0.1297 | 0.2077 | -0.0336 |
| 3000000. | 10.00 | 270.0000 | 0.2545 | 0.1513 | 0.2032 | -0.0247 |
| 3000000. | 10.00 | 285.0000 | 0.2564 | 0.1664 | 0.1950 | -0.0026 |
| 3000000. | 10.00 | 300.0000 | 0.2472 | 0.1593 | 0.1872 | 0.0264 |
| 3000000. | 10.00 | 315.0000 | 0.2312 | 0.1308 | 0.1838 | 0.0508 |
| 3000000. | 10.00 | 330.0000 | 0.2149 | 0.0860 | 0.1861 | 0.0643 |
| 3000000. | 10.00 | 345.0000 | 0.2057 | 0.0375 | 0.1940 | 0.0574 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 3000000. | 20.00 | 0. | 0.2296 | 0.0937 | 0.2072 | 0.0314 |
| 3000000. | 20.00 | 15.0000 | 0.2329 | 0.0899 | 0.2142 | 0.0155 |
| 3000000. | 20.00 | 30.0000 | 0.2398 | 0.0957 | 0.2198 | 0.0039 |
| 3000000. | 20.00 | 45.0000 | 0.2491 | 0.1051 | 0.2258 | -0.0001 |
| 3000000. | 20.00 | 60.0000 | 0.2595 | 0.1130 | 0.2336 | 0.0019 |
| 3000000. | 20.00 | 75.0000 | 0.2687 | 0.1146 | 0.2430 | 0.0049 |
| 3000000. | 20.00 | 90.0000 | 0.2746 | 0.1128 | 0.2503 | 0.0041 |
| 3000000. | 20.00 | 105.0000 | 0.2751 | 0.1125 | 0.2511 | -0.0001 |
| 3000000. | 20.00 | 120.0000 | 0.2699 | 0.1145 | 0.2444 | -0.0011 |
| 3000000. | 20.00 | 135.0000 | 0.2584 | 0.1105 | 0.2336 | -0.0012 |
| 3000000. | 20.00 | 150.0000 | 0.2455 | 0.1051 | 0.2217 | -0.0080 |
| 3000000. | 20.00 | 165.0000 | 0.2366 | 0.1079 | 0.2096 | -0.0197 |
| 3000000. | 20.00 | 180.0000 | 0.2349 | 0.1192 | 0.2004 | -0.0289 |
| 3000000. | 20.00 | 195.0000 | 0.2398 | 0.1341 | 0.1957 | -0.0346 |
| 3000000. | 20.00 | 210.0000 | 0.2485 | 0.1503 | 0.1943 | -0.0373 |
| 3000000. | 20.00 | 225.0000 | 0.2607 | 0.1680 | 0.1955 | -0.0386 |
| 3000000. | 20.00 | 240.0000 | 0.2741 | 0.1873 | 0.1966 | -0.0377 |
| 3000000. | 20.00 | 255.0000 | 0.2871 | 0.2083 | 0.1947 | -0.0330 |
| 3000000. | 20.00 | 270.0000 | 0.2966 | 0.2284 | 0.1882 | -0.0203 |
| 3000000. | 20.00 | 285.0000 | 0.2971 | 0.2372 | 0.1788 | 0.0037 |
| 3000000. | 20.00 | 300.0000 | 0.2852 | 0.2248 | 0.1728 | 0.0310 |
| 3000000. | 20.00 | 315.0000 | 0.2655 | 0.1944 | 0.1733 | 0.0519 |
| 3000000. | 20.00 | 330.0000 | 0.2449 | 0.1527 | 0.1814 | 0.0610 |
| 3000000. | 20.00 | 345.0000 | 0.2319 | 0.1134 | 0.1956 | 0.0513 |
| | | | | | | |
| 3000000. | 30.00 | 0. | 0.2610 | 0.1742 | 0.1924 | 0.0274 |
| 3000000. | 30.00 | 15.0000 | 0.2632 | 0.1720 | 0.1987 | 0.0130 |
| 3000000. | 30.00 | 30.0000 | 0.2699 | 0.1783 | 0.2026 | 0.0007 |
| 3000000. | 30.00 | 45.0000 | 0.2807 | 0.1899 | 0.2067 | -0.0047 |
| 3000000. | 30.00 | 60.0000 | 0.2926 | 0.2012 | 0.2124 | -0.0039 |
| 3000000. | 30.00 | 75.0000 | 0.3019 | 0.2072 | 0.2195 | -0.0010 |
| 3000000. | 30.00 | 90.0000 | 0.3081 | 0.2094 | 0.2259 | 0.0009 |
| 3000000. | 30.00 | 105.0000 | 0.3090 | 0.2091 | 0.2275 | 0.0021 |
| 3000000. | 30.00 | 120.0000 | 0.3024 | 0.2045 | 0.2227 | 0.0053 |
| 3000000. | 30.00 | 135.0000 | 0.2887 | 0.1926 | 0.2150 | 0.0065 |
| 3000000. | 30.00 | 150.0000 | 0.2727 | 0.1793 | 0.2054 | 0.0001 |
| 3000000. | 30.00 | 165.0000 | 0.2612 | 0.1734 | 0.1949 | -0.0127 |
| 3000000. | 30.00 | 180.0000 | 0.2580 | 0.1789 | 0.1853 | -0.0257 |
| 3000000. | 30.00 | 195.0000 | 0.2660 | 0.1934 | 0.1793 | -0.0349 |
| 3000000. | 30.00 | 210.0000 | 0.2786 | 0.2117 | 0.1767 | -0.0401 |
| 3000000. | 30.00 | 225.0000 | 0.2955 | 0.2338 | 0.1757 | -0.0424 |
| 3000000. | 30.00 | 240.0000 | 0.3133 | 0.2576 | 0.1739 | -0.0400 |
| 3000000. | 30.00 | 255.0000 | 0.3290 | 0.2802 | 0.1695 | -0.0319 |
| 3000000. | 30.00 | 270.0000 | 0.3378 | 0.2965 | 0.1613 | -0.0149 |
| 3000000. | 30.00 | 285.0000 | 0.3356 | 0.2984 | 0.1532 | 0.0096 |
| 3000000. | 30.00 | 300.0000 | 0.3215 | 0.2821 | 0.1504 | 0.0346 |
| 3000000. | 30.00 | 315.0000 | 0.3002 | 0.2519 | 0.1550 | 0.0515 |
| 3000000. | 30.00 | 330.0000 | 0.2788 | 0.2160 | 0.1673 | 0.0553 |
| 3000000. | 30.00 | 345.0000 | 0.2658 | 0.1881 | 0.1822 | 0.0451 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 3000000. | 40.00 | 0. | 0.2924 | 0.2399 | 0.1652 | 0.0249 |
| 3000000. | 40.00 | 15.0000 | 0.2941 | 0.2393 | 0.1706 | 0.0105 |
| 3000000. | 40.00 | 30.0000 | 0.3010 | 0.2460 | 0.1734 | -0.0014 |
| 3000000. | 40.00 | 45.0000 | 0.3118 | 0.2578 | 0.1752 | -0.0083 |
| 3000000. | 40.00 | 60.0000 | 0.3251 | 0.2715 | 0.1785 | -0.0094 |
| 3000000. | 40.00 | 75.0000 | 0.3363 | 0.2816 | 0.1837 | -0.0066 |
| 3000000. | 40.00 | 90.0000 | 0.3446 | 0.2884 | 0.1887 | -0.0031 |
| 3000000. | 40.00 | 105.0000 | 0.3475 | 0.2901 | 0.1913 | 0.0030 |
| 3000000. | 40.00 | 120.0000 | 0.3405 | 0.2822 | 0.1903 | 0.0099 |
| 3000000. | 40.00 | 135.0000 | 0.3254 | 0.2657 | 0.1874 | 0.0131 |
| 3000000. | 40.00 | 150.0000 | 0.3070 | 0.2463 | 0.1831 | 0.0070 |
| 3000000. | 40.00 | 165.0000 | 0.2945 | 0.2353 | 0.1770 | -0.0065 |
| 3000000. | 40.00 | 180.0000 | 0.2912 | 0.2359 | 0.1693 | -0.0223 |
| 3000000. | 40.00 | 195.0000 | 0.2987 | 0.2486 | 0.1619 | -0.0347 |
| 3000000. | 40.00 | 210.0000 | 0.3127 | 0.2678 | 0.1558 | -0.0424 |
| 3000000. | 40.00 | 225.0000 | 0.3312 | 0.2918 | 0.1501 | -0.0448 |
| 3000000. | 40.00 | 240.0000 | 0.3497 | 0.3163 | 0.1434 | -0.0408 |
| 3000000. | 40.00 | 255.0000 | 0.3649 | 0.3379 | 0.1347 | -0.0291 |
| 3000000. | 40.00 | 270.0000 | 0.3711 | 0.3491 | 0.1254 | -0.0092 |
| 3000000. | 40.00 | 285.0000 | 0.3664 | 0.3460 | 0.1198 | 0.0147 |
| 3000000. | 40.00 | 300.0000 | 0.3509 | 0.3273 | 0.1210 | 0.0366 |
| 3000000. | 40.00 | 315.0000 | 0.3307 | 0.3002 | 0.1298 | 0.0490 |
| 3000000. | 40.00 | 330.0000 | 0.3121 | 0.2728 | 0.1434 | 0.0494 |
| 3000000. | 40.00 | 345.0000 | 0.2993 | 0.2520 | 0.1563 | 0.0407 |
| 3000000. | 50.00 | 0. | 0.3201 | 0.2896 | 0.1341 | 0.0226 |
| 3000000. | 50.00 | 15.0000 | 0.3216 | 0.2899 | 0.1389 | 0.0088 |
| 3000000. | 50.00 | 30.0000 | 0.3277 | 0.2961 | 0.1403 | -0.0027 |
| 3000000. | 50.00 | 45.0000 | 0.3379 | 0.3073 | 0.1401 | -0.0108 |
| 3000000. | 50.00 | 60.0000 | 0.3511 | 0.3218 | 0.1399 | -0.0140 |
| 3000000. | 50.00 | 75.0000 | 0.3641 | 0.3351 | 0.1418 | -0.0122 |
| 3000000. | 50.00 | 90.0000 | 0.3742 | 0.3451 | 0.1444 | -0.0070 |
| 3000000. | 50.00 | 105.0000 | 0.3778 | 0.3483 | 0.1464 | 0.0020 |
| 3000000. | 50.00 | 120.0000 | 0.3729 | 0.3414 | 0.1496 | 0.0109 |
| 3000000. | 50.00 | 135.0000 | 0.3606 | 0.3260 | 0.1534 | 0.0155 |
| 3000000. | 50.00 | 150.0000 | 0.3448 | 0.3074 | 0.1558 | 0.0104 |
| 3000000. | 50.00 | 165.0000 | 0.3329 | 0.2950 | 0.1543 | -0.0021 |
| 3000000. | 50.00 | 180.0000 | 0.3278 | 0.2917 | 0.1484 | -0.0182 |
| 3000000. | 50.00 | 195.0000 | 0.3323 | 0.2999 | 0.1392 | -0.0327 |
| 3000000. | 50.00 | 210.0000 | 0.3448 | 0.3169 | 0.1293 | -0.0423 |
| 3000000. | 50.00 | 225.0000 | 0.3619 | 0.3391 | 0.1184 | -0.0445 |
| 3000000. | 50.00 | 240.0000 | 0.3780 | 0.3607 | 0.1067 | -0.0383 |
| 3000000. | 50.00 | 255.0000 | 0.3886 | 0.3762 | 0.0947 | -0.0235 |
| 3000000. | 50.00 | 270.0000 | 0.3901 | 0.3806 | 0.0856 | -0.0033 |
| 3000000. | 50.00 | 285.0000 | 0.3840 | 0.3745 | 0.0831 | 0.0178 |
| 3000000. | 50.00 | 300.0000 | 0.3710 | 0.3584 | 0.0888 | 0.0360 |
| 3000000. | 50.00 | 315.0000 | 0.3538 | 0.3363 | 0.0996 | 0.0458 |
| 3000000. | 50.00 | 330.0000 | 0.3372 | 0.3147 | 0.1123 | 0.0452 |
| 3000000. | 50.00 | 345.0000 | 0.3253 | 0.2983 | 0.1246 | 0.0366 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 3000000. | 60.00 | 0. | 0.3426 | 0.3263 | 0.1052 | 0.0203 |
| 3000000. | 60.00 | 15.0000 | 0.3440 | 0.3268 | 0.1071 | 0.0082 |
| 3000000. | 60.00 | 30.0000 | 0.3486 | 0.3317 | 0.1073 | -0.0028 |
| 3000000. | 60.00 | 45.0000 | 0.3564 | 0.3404 | 0.1051 | -0.0113 |
| 3000000. | 60.00 | 60.0000 | 0.3672 | 0.3523 | 0.1021 | -0.0166 |
| 3000000. | 60.00 | 75.0000 | 0.3805 | 0.3667 | 0.1003 | -0.0171 |
| 3000000. | 60.00 | 90.0000 | 0.3922 | 0.3790 | 0.1003 | -0.0112 |
| 3000000. | 60.00 | 105.0000 | 0.3975 | 0.3840 | 0.1027 | -0.0016 |
| 3000000. | 60.00 | 120.0000 | 0.3961 | 0.3812 | 0.1072 | 0.0075 |
| 3000000. | 60.00 | 135.0000 | 0.3882 | 0.3712 | 0.1131 | 0.0129 |
| 3000000. | 60.00 | 150.0000 | 0.3762 | 0.3570 | 0.1184 | 0.0101 |
| 3000000. | 60.00 | 165.0000 | 0.3664 | 0.3460 | 0.1203 | -0.0004 |
| 3000000. | 60.00 | 180.0000 | 0.3614 | 0.3414 | 0.1178 | -0.0144 |
| 3000000. | 60.00 | 195.0000 | 0.3632 | 0.3450 | 0.1100 | -0.0285 |
| 3000000. | 60.00 | 210.0000 | 0.3718 | 0.3567 | 0.0977 | -0.0379 |
| 3000000. | 60.00 | 225.0000 | 0.3833 | 0.3721 | 0.0831 | -0.0392 |
| 3000000. | 60.00 | 240.0000 | 0.3939 | 0.3865 | 0.0688 | -0.0319 |
| 3000000. | 60.00 | 255.0000 | 0.3995 | 0.3950 | 0.0575 | -0.0165 |
| 3000000. | 60.00 | 270.0000 | 0.3975 | 0.3942 | 0.0515 | 0.0021 |
| 3000000. | 60.00 | 285.0000 | 0.3908 | 0.3869 | 0.0516 | 0.0193 |
| 3000000. | 60.00 | 300.0000 | 0.3810 | 0.3750 | 0.0580 | 0.0337 |
| 3000000. | 60.00 | 315.0000 | 0.3679 | 0.3588 | 0.0697 | 0.0420 |
| 3000000. | 60.00 | 330.0000 | 0.3546 | 0.3423 | 0.0831 | 0.0408 |
| 3000000. | 60.00 | 345.0000 | 0.3459 | 0.3310 | 0.0950 | 0.0323 |
| | | | | | | |
| 3000000. | 70.00 | 0. | 0.3614 | 0.3532 | 0.0740 | 0.0188 |
| 3000000. | 70.00 | 15.0000 | 0.3619 | 0.3534 | 0.0777 | 0.0085 |
| 3000000. | 70.00 | 30.0000 | 0.3647 | 0.3562 | 0.0779 | -0.0014 |
| 3000000. | 70.00 | 45.0000 | 0.3696 | 0.3617 | 0.0755 | -0.0100 |
| 3000000. | 70.00 | 60.0000 | 0.3773 | 0.3702 | 0.0711 | -0.0165 |
| 3000000. | 70.00 | 75.0000 | 0.3874 | 0.3813 | 0.0658 | -0.0188 |
| 3000000. | 70.00 | 90.0000 | 0.3976 | 0.3925 | 0.0617 | -0.0156 |
| 3000000. | 70.00 | 105.0000 | 0.4045 | 0.3998 | 0.0610 | -0.0077 |
| 3000000. | 70.00 | 120.0000 | 0.4063 | 0.4012 | 0.0640 | 0.0008 |
| 3000000. | 70.00 | 135.0000 | 0.4026 | 0.3965 | 0.0697 | 0.0062 |
| 3000000. | 70.00 | 150.0000 | 0.3958 | 0.3884 | 0.0760 | 0.0052 |
| 3000000. | 70.00 | 165.0000 | 0.3897 | 0.3814 | 0.0796 | -0.0021 |
| 3000000. | 70.00 | 180.0000 | 0.3865 | 0.3783 | 0.0783 | -0.0124 |
| 3000000. | 70.00 | 195.0000 | 0.3867 | 0.3793 | 0.0716 | -0.0223 |
| 3000000. | 70.00 | 210.0000 | 0.3897 | 0.3839 | 0.0605 | -0.0286 |
| 3000000. | 70.00 | 225.0000 | 0.3943 | 0.3904 | 0.0472 | -0.0290 |
| 3000000. | 70.00 | 240.0000 | 0.3990 | 0.3968 | 0.0347 | -0.0224 |
| 3000000. | 70.00 | 255.0000 | 0.4011 | 0.4002 | 0.0259 | -0.0097 |
| 3000000. | 70.00 | 270.0000 | 0.3991 | 0.3984 | 0.0229 | 0.0058 |
| 3000000. | 70.00 | 285.0000 | 0.3934 | 0.3920 | 0.0255 | 0.0202 |
| 3000000. | 70.00 | 300.0000 | 0.3855 | 0.3828 | 0.0330 | 0.0309 |
| 3000000. | 70.00 | 315.0000 | 0.3767 | 0.3724 | 0.0440 | 0.0363 |
| 3000000. | 70.00 | 330.0000 | 0.3688 | 0.3628 | 0.0563 | 0.0351 |
| 3000000. | 70.00 | 345.0000 | 0.3635 | 0.3562 | 0.0668 | 0.0284 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 3000000. | 80.00 | 0. | 0.3778 | 0.3746 | 0.0457 | 0.0170 |
| 3000000. | 80.00 | 15.0000 | 0.3783 | 0.3749 | 0.0492 | 0.0089 |
| 3000000. | 80.00 | 30.0000 | 0.3800 | 0.3767 | 0.0499 | 0.0007 |
| 3000000. | 80.00 | 45.0000 | 0.3828 | 0.3797 | 0.0480 | -0.0066 |
| 3000000. | 80.00 | 60.0000 | 0.3865 | 0.3838 | 0.0440 | -0.0122 |
| 3000000. | 80.00 | 75.0000 | 0.3910 | 0.3887 | 0.0387 | -0.0151 |
| 3000000. | 80.00 | 90.0000 | 0.3954 | 0.3937 | 0.0336 | -0.0150 |
| 3000000. | 80.00 | 105.0000 | 0.3990 | 0.3977 | 0.0301 | -0.0123 |
| 3000000. | 80.00 | 120.0000 | 0.4012 | 0.4000 | 0.0291 | -0.0086 |
| 3000000. | 80.00 | 135.0000 | 0.4016 | 0.4004 | 0.0302 | -0.0059 |
| 3000000. | 80.00 | 150.0000 | 0.4007 | 0.3993 | 0.0323 | -0.0056 |
| 3000000. | 80.00 | 165.0000 | 0.3991 | 0.3977 | 0.0334 | -0.0078 |
| 3000000. | 80.00 | 180.0000 | 0.3977 | 0.3962 | 0.0320 | -0.0116 |
| 3000000. | 80.00 | 195.0000 | 0.3968 | 0.3955 | 0.0278 | -0.0152 |
| 3000000. | 80.00 | 210.0000 | 0.3964 | 0.3955 | 0.0212 | -0.0168 |
| 3000000. | 80.00 | 225.0000 | 0.3965 | 0.3960 | 0.0135 | -0.0153 |
| 3000000. | 80.00 | 240.0000 | 0.3966 | 0.3964 | 0.0064 | -0.0100 |
| 3000000. | 80.00 | 255.0000 | 0.3960 | 0.3960 | 0.0018 | -0.0015 |
| 3000000. | 80.00 | 270.0000 | 0.3943 | 0.3942 | 0.0011 | 0.0086 |
| 3000000. | 80.00 | 285.0000 | 0.3915 | 0.3910 | 0.0047 | 0.0182 |
| 3000000. | 80.00 | 300.0000 | 0.3878 | 0.3868 | 0.0118 | 0.0254 |
| 3000000. | 80.00 | 315.0000 | 0.3840 | 0.3824 | 0.0210 | 0.0288 |
| 3000000. | 80.00 | 330.0000 | 0.3808 | 0.3785 | 0.0308 | 0.0281 |
| 3000000. | 80.00 | 345.0000 | 0.3786 | 0.3758 | 0.0393 | 0.0238 |
| 3000000. | 90.00 | 0. | 0.3925 | 0.3920 | 0 | 0 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 4000000. | -90.00 | 0. | 0.3391 | -0.3307 | 0 | 0 |
| 4000000. | -80.00 | 0. | 0.3110 | -0.2976 | 0.0785 | 0.0443 |
| 4000000. | -80.00 | 15.0000 | 0.3150 | -0.3029 | 0.0660 | 0.0560 |
| 4000000. | -80.00 | 30.0000 | 0.3202 | -0.3094 | 0.0513 | 0.0643 |
| 4000000. | -80.00 | 45.0000 | 0.3262 | -0.3168 | 0.0353 | 0.0689 |
| 4000000. | -80.00 | 60.0000 | 0.3328 | -0.3249 | 0.0186 | 0.0698 |
| 4000000. | -80.00 | 75.0000 | 0.3400 | -0.3334 | 0.0012 | 0.0667 |
| 4000000. | -80.00 | 90.0000 | 0.3474 | -0.3420 | -0.0139 | 0.0594 |
| 4000000. | -80.00 | 105.0000 | 0.3546 | -0.3503 | -0.0277 | 0.0477 |
| 4000000. | -80.00 | 120.0000 | 0.3608 | -0.3574 | -0.0381 | 0.0323 |
| 4000000. | -80.00 | 135.0000 | 0.3658 | -0.3628 | -0.0443 | 0.0141 |
| 4000000. | -80.00 | 150.0000 | 0.3689 | -0.3659 | -0.0458 | -0.0058 |
| 4000000. | -80.00 | 165.0000 | 0.3696 | -0.3663 | -0.0421 | -0.0262 |
| 4000000. | -80.00 | 180.0000 | 0.3676 | -0.3633 | -0.0331 | -0.0454 |
| 4000000. | -80.00 | 195.0000 | 0.3627 | -0.3569 | -0.0192 | -0.0614 |
| 4000000. | -80.00 | 210.0000 | 0.3553 | -0.3478 | -0.0017 | -0.0724 |
| 4000000. | -80.00 | 225.0000 | 0.3464 | -0.3371 | 0.0179 | -0.0776 |
| 4000000. | -80.00 | 240.0000 | 0.3369 | -0.3260 | 0.0378 | -0.0765 |
| 4000000. | -80.00 | 255.0000 | 0.3281 | -0.3155 | 0.0565 | -0.0697 |
| 4000000. | -80.00 | 270.0000 | 0.3204 | -0.3067 | 0.0726 | -0.0579 |
| 4000000. | -80.00 | 285.0000 | 0.3145 | -0.2998 | 0.0849 | -0.0424 |
| 4000000. | -80.00 | 300.0000 | 0.3104 | -0.2952 | 0.0927 | -0.0245 |
| 4000000. | -80.00 | 315.0000 | 0.3081 | -0.2928 | 0.0956 | -0.0058 |
| 4000000. | -80.00 | 330.0000 | 0.3074 | -0.2924 | 0.0940 | 0.0126 |
| 4000000. | -80.00 | 345.0000 | 0.3084 | -0.2941 | 0.0881 | 0.0295 |
| 4000000. | -70.00 | 0. | 0.2784 | -0.2591 | 0.0922 | 0.0434 |
| 4000000. | -70.00 | 15.0000 | 0.2859 | -0.2689 | 0.0814 | 0.0532 |
| 4000000. | -70.00 | 30.0000 | 0.2958 | -0.2811 | 0.0697 | 0.0599 |
| 4000000. | -70.00 | 45.0000 | 0.3070 | -0.2948 | 0.0571 | 0.0639 |
| 4000000. | -70.00 | 60.0000 | 0.3192 | -0.3094 | 0.0437 | 0.0653 |
| 4000000. | -70.00 | 75.0000 | 0.3329 | -0.3254 | 0.0298 | 0.0639 |
| 4000000. | -70.00 | 90.0000 | 0.3478 | -0.3425 | 0.0160 | 0.0580 |
| 4000000. | -70.00 | 105.0000 | 0.3619 | -0.3589 | 0.0041 | 0.0463 |
| 4000000. | -70.00 | 120.0000 | 0.3731 | -0.3718 | -0.0037 | 0.0301 |
| 4000000. | -70.00 | 135.0000 | 0.3810 | -0.3807 | -0.0067 | 0.0119 |
| 4000000. | -70.00 | 150.0000 | 0.3863 | -0.3862 | -0.0052 | -0.0068 |
| 4000000. | -70.00 | 165.0000 | 0.3885 | -0.3875 | 0.0003 | -0.0264 |
| 4000000. | -70.00 | 180.0000 | 0.3852 | -0.3823 | 0.0102 | -0.0456 |
| 4000000. | -70.00 | 195.0000 | 0.3757 | -0.3700 | 0.0235 | -0.0607 |
| 4000000. | -70.00 | 210.0000 | 0.3618 | -0.3530 | 0.0380 | -0.0698 |
| 4000000. | -70.00 | 225.0000 | 0.3459 | -0.3340 | 0.0522 | -0.0734 |
| 4000000. | -70.00 | 240.0000 | 0.3294 | -0.3144 | 0.0663 | -0.0725 |
| 4000000. | -70.00 | 255.0000 | 0.3133 | -0.2952 | 0.0806 | -0.0669 |
| 4000000. | -70.00 | 270.0000 | 0.2988 | -0.2779 | 0.0944 | -0.0561 |
| 4000000. | -70.00 | 285.0000 | 0.2873 | -0.2641 | 0.1056 | -0.0402 |
| 4000000. | -70.00 | 300.0000 | 0.2794 | -0.2550 | 0.1120 | -0.0214 |
| 4000000. | -70.00 | 315.0000 | 0.2748 | -0.2505 | 0.1130 | -0.0022 |
| 4000000. | -70.00 | 330.0000 | 0.2730 | -0.2498 | 0.1091 | 0.0154 |
| 4000000. | -70.00 | 345.0000 | 0.2741 | -0.2527 | 0.1018 | 0.0308 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 4000000. | -60.00 | 0. | 0.2447 | -0.2211 | 0.0955 | 0.0428 |
| 4000000. | -60.00 | 15.0000 | 0.2541 | -0.2337 | 0.0870 | 0.0490 |
| 4000000. | -60.00 | 30.0000 | 0.2669 | -0.2489 | 0.0798 | 0.0540 |
| 4000000. | -60.00 | 45.0000 | 0.2822 | -0.2666 | 0.0724 | 0.0578 |
| 4000000. | -60.00 | 60.0000 | 0.2995 | -0.2864 | 0.0637 | 0.0602 |
| 4000000. | -60.00 | 75.0000 | 0.3189 | -0.3085 | 0.0540 | 0.0597 |
| 4000000. | -60.00 | 90.0000 | 0.3395 | -0.3321 | 0.0446 | 0.0544 |
| 4000000. | -60.00 | 105.0000 | 0.3592 | -0.3547 | 0.0371 | 0.0428 |
| 4000000. | -60.00 | 120.0000 | 0.3746 | -0.3722 | 0.0330 | 0.0255 |
| 4000000. | -60.00 | 135.0000 | 0.3838 | -0.3823 | 0.0340 | 0.0063 |
| 4000000. | -60.00 | 150.0000 | 0.3883 | -0.3860 | 0.0398 | -0.0122 |
| 4000000. | -60.00 | 165.0000 | 0.3880 | -0.3837 | 0.0489 | -0.0302 |
| 4000000. | -60.00 | 180.0000 | 0.3804 | -0.3727 | 0.0598 | -0.0472 |
| 4000000. | -60.00 | 195.0000 | 0.3653 | -0.3535 | 0.0710 | -0.0586 |
| 4000000. | -60.00 | 210.0000 | 0.3473 | -0.3317 | 0.0810 | -0.0634 |
| 4000000. | -60.00 | 225.0000 | 0.3298 | -0.3110 | 0.0893 | -0.0643 |
| 4000000. | -60.00 | 240.0000 | 0.3126 | -0.2903 | 0.0969 | -0.0641 |
| 4000000. | -60.00 | 255.0000 | 0.2940 | -0.2674 | 0.1055 | -0.0616 |
| 4000000. | -60.00 | 270.0000 | 0.2746 | -0.2436 | 0.1151 | -0.0534 |
| 4000000. | -60.00 | 285.0000 | 0.2573 | -0.2227 | 0.1232 | -0.0382 |
| 4000000. | -60.00 | 300.0000 | 0.2448 | -0.2086 | 0.1269 | -0.0177 |
| 4000000. | -60.00 | 315.0000 | 0.2381 | -0.2031 | 0.1242 | 0.0033 |
| 4000000. | -60.00 | 330.0000 | 0.2361 | -0.2045 | 0.1162 | 0.0209 |
| 4000000. | -60.00 | 345.0000 | 0.2385 | -0.2110 | 0.1058 | 0.0340 |
| 4000000. | -50.00 | 0. | 0.2172 | -0.1912 | 0.0938 | 0.0427 |
| 4000000. | -50.00 | 15.0000 | 0.2284 | -0.2062 | 0.0875 | 0.0443 |
| 4000000. | -50.00 | 30.0000 | 0.2417 | -0.2215 | 0.0847 | 0.0465 |
| 4000000. | -50.00 | 45.0000 | 0.2583 | -0.2395 | 0.0827 | 0.0503 |
| 4000000. | -50.00 | 60.0000 | 0.2788 | -0.2618 | 0.0794 | 0.0540 |
| 4000000. | -50.00 | 75.0000 | 0.3025 | -0.2882 | 0.0744 | 0.0545 |
| 4000000. | -50.00 | 90.0000 | 0.3269 | -0.3157 | 0.0694 | 0.0489 |
| 4000000. | -50.00 | 105.0000 | 0.3495 | -0.3409 | 0.0673 | 0.0366 |
| 4000000. | -50.00 | 120.0000 | 0.3661 | -0.3590 | 0.0692 | 0.0187 |
| 4000000. | -50.00 | 135.0000 | 0.3744 | -0.3669 | 0.0747 | -0.0010 |
| 4000000. | -50.00 | 150.0000 | 0.3741 | -0.3642 | 0.0833 | -0.0189 |
| 4000000. | -50.00 | 165.0000 | 0.3682 | -0.3547 | 0.0927 | -0.0337 |
| 4000000. | -50.00 | 180.0000 | 0.3565 | -0.3386 | 0.1012 | -0.0465 |
| 4000000. | -50.00 | 195.0000 | 0.3389 | -0.3167 | 0.1080 | -0.0541 |
| 4000000. | -50.00 | 210.0000 | 0.3199 | -0.2939 | 0.1130 | -0.0564 |
| 4000000. | -50.00 | 225.0000 | 0.3023 | -0.2728 | 0.1177 | -0.0561 |
| 4000000. | -50.00 | 240.0000 | 0.2861 | -0.2525 | 0.1222 | -0.0561 |
| 4000000. | -50.00 | 255.0000 | 0.2673 | -0.2286 | 0.1271 | -0.0553 |
| 4000000. | -50.00 | 270.0000 | 0.2460 | -0.2016 | 0.1321 | -0.0489 |
| 4000000. | -50.00 | 285.0000 | 0.2254 | -0.1766 | 0.1358 | -0.0341 |
| 4000000. | -50.00 | 300.0000 | 0.2101 | -0.1605 | 0.1350 | -0.0120 |
| 4000000. | -50.00 | 315.0000 | 0.2032 | -0.1574 | 0.1281 | 0.0107 |
| 4000000. | -50.00 | 330.0000 | 0.2034 | -0.1643 | 0.1166 | 0.0280 |
| 4000000. | -50.00 | 345.0000 | 0.2086 | -0.1767 | 0.1040 | 0.0382 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 4000000. | -40.00 | 0. | 0.1984 | -0.1700 | 0.0932 | 0.0423 |
| 4000000. | -40.00 | 15.0000 | 0.2099 | -0.1856 | 0.0900 | 0.0392 |
| 4000000. | -40.00 | 30.0000 | 0.2223 | -0.1992 | 0.0907 | 0.0392 |
| 4000000. | -40.00 | 45.0000 | 0.2385 | -0.2157 | 0.0928 | 0.0420 |
| 4000000. | -40.00 | 60.0000 | 0.2598 | -0.2372 | 0.0953 | 0.0464 |
| 4000000. | -40.00 | 75.0000 | 0.2862 | -0.2652 | 0.0963 | 0.0480 |
| 4000000. | -40.00 | 90.0000 | 0.3130 | -0.2945 | 0.0974 | 0.0418 |
| 4000000. | -40.00 | 105.0000 | 0.3355 | -0.3187 | 0.1009 | 0.0285 |
| 4000000. | -40.00 | 120.0000 | 0.3499 | -0.3329 | 0.1075 | 0.0106 |
| 4000000. | -40.00 | 135.0000 | 0.3547 | -0.3354 | 0.1151 | -0.0072 |
| 4000000. | -40.00 | 150.0000 | 0.3503 | -0.3277 | 0.1217 | -0.0229 |
| 4000000. | -40.00 | 165.0000 | 0.3404 | -0.3134 | 0.1282 | -0.0351 |
| 4000000. | -40.00 | 180.0000 | 0.3260 | -0.2938 | 0.1341 | -0.0447 |
| 4000000. | -40.00 | 195.0000 | 0.3078 | -0.2708 | 0.1379 | -0.0490 |
| 4000000. | -40.00 | 210.0000 | 0.2904 | -0.2494 | 0.1401 | -0.0499 |
| 4000000. | -40.00 | 225.0000 | 0.2736 | -0.2286 | 0.1419 | -0.0500 |
| 4000000. | -40.00 | 240.0000 | 0.2569 | -0.2072 | 0.1435 | -0.0498 |
| 4000000. | -40.00 | 255.0000 | 0.2383 | -0.1832 | 0.1444 | -0.0489 |
| 4000000. | -40.00 | 270.0000 | 0.2173 | -0.1560 | 0.1449 | -0.0431 |
| 4000000. | -40.00 | 285.0000 | 0.1965 | -0.1308 | 0.1439 | -0.0284 |
| 4000000. | -40.00 | 300.0000 | 0.1815 | -0.1162 | 0.1393 | -0.0057 |
| 4000000. | -40.00 | 315.0000 | 0.1762 | -0.1175 | 0.1300 | 0.0183 |
| 4000000. | -40.00 | 330.0000 | 0.1792 | -0.1312 | 0.1169 | 0.0354 |
| 4000000. | -40.00 | 345.0000 | 0.1877 | -0.1510 | 0.1030 | 0.0427 |
| | | | | | | |
| 4000000. | -30.00 | 0. | 0.1885 | -0.1543 | 0.0997 | 0.0419 |
| 4000000. | -30.00 | 15.0000 | 0.1982 | -0.1689 | 0.0980 | 0.0341 |
| 4000000. | -30.00 | 30.0000 | 0.2092 | -0.1801 | 0.1015 | 0.0323 |
| 4000000. | -30.00 | 45.0000 | 0.2241 | -0.1936 | 0.1077 | 0.0332 |
| 4000000. | -30.00 | 60.0000 | 0.2431 | -0.2109 | 0.1149 | 0.0375 |
| 4000000. | -30.00 | 75.0000 | 0.2681 | -0.2356 | 0.1216 | 0.0396 |
| 4000000. | -30.00 | 90.0000 | 0.2937 | -0.2622 | 0.1280 | 0.0334 |
| 4000000. | -30.00 | 105.0000 | 0.3136 | -0.2818 | 0.1363 | 0.0196 |
| 4000000. | -30.00 | 120.0000 | 0.3240 | -0.2893 | 0.1459 | 0.0027 |
| 4000000. | -30.00 | 135.0000 | 0.3247 | -0.2859 | 0.1536 | -0.0115 |
| 4000000. | -30.00 | 150.0000 | 0.3189 | -0.2759 | 0.1582 | -0.0243 |
| 4000000. | -30.00 | 165.0000 | 0.3075 | -0.2594 | 0.1616 | -0.0347 |
| 4000000. | -30.00 | 180.0000 | 0.2919 | -0.2382 | 0.1635 | -0.0417 |
| 4000000. | -30.00 | 195.0000 | 0.2748 | -0.2161 | 0.1638 | -0.0445 |
| 4000000. | -30.00 | 210.0000 | 0.2587 | -0.1951 | 0.1638 | -0.0449 |
| 4000000. | -30.00 | 225.0000 | 0.2431 | -0.1747 | 0.1630 | -0.0444 |
| 4000000. | -30.00 | 240.0000 | 0.2277 | -0.1549 | 0.1612 | -0.0435 |
| 4000000. | -30.00 | 255.0000 | 0.2117 | -0.1331 | 0.1590 | -0.0426 |
| 4000000. | -30.00 | 270.0000 | 0.1937 | -0.1081 | 0.1565 | -0.0368 |
| 4000000. | -30.00 | 285.0000 | 0.1762 | -0.0855 | 0.1525 | -0.0220 |
| 4000000. | -30.00 | 300.0000 | 0.1635 | -0.0746 | 0.1455 | 0.0015 |
| 4000000. | -30.00 | 315.0000 | 0.1595 | -0.0814 | 0.1348 | 0.0255 |
| 4000000. | -30.00 | 330.0000 | 0.1644 | -0.1024 | 0.1216 | 0.0422 |
| 4000000. | -30.00 | 345.0000 | 0.1760 | -0.1302 | 0.1086 | 0.0473 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 4000000. | 0.00 | 0. | 0.1755 | -0.0507 | 0.1638 | 0.0371 |
| 4000000. | 0.00 | 15.0000 | 0.1829 | -0.0628 | 0.1703 | 0.0224 |
| 4000000. | 0.00 | 30.0000 | 0.1889 | -0.0644 | 0.1771 | 0.0130 |
| 4000000. | 0.00 | 45.0000 | 0.1950 | -0.0614 | 0.1848 | 0.0105 |
| 4000000. | 0.00 | 60.0000 | 0.2042 | -0.0625 | 0.1940 | 0.0139 |
| 4000000. | 0.00 | 75.0000 | 0.2161 | -0.0709 | 0.2034 | 0.0161 |
| 4000000. | 0.00 | 90.0000 | 0.2273 | -0.0806 | 0.2122 | 0.0107 |
| 4000000. | 0.00 | 105.0000 | 0.2321 | -0.0804 | 0.2178 | -0.0004 |
| 4000000. | 0.00 | 120.0000 | 0.2299 | -0.0713 | 0.2184 | -0.0081 |
| 4000000. | 0.00 | 135.0000 | 0.2243 | -0.0625 | 0.2151 | -0.0122 |
| 4000000. | 0.00 | 150.0000 | 0.2174 | -0.0543 | 0.2097 | -0.0196 |
| 4000000. | 0.00 | 165.0000 | 0.2098 | -0.0414 | 0.2039 | -0.0269 |
| 4000000. | 0.00 | 180.0000 | 0.2027 | -0.0244 | 0.1987 | -0.0317 |
| 4000000. | 0.00 | 195.0000 | 0.1976 | -0.0082 | 0.1946 | -0.0331 |
| 4000000. | 0.00 | 210.0000 | 0.1941 | 0.0056 | 0.1912 | -0.0329 |
| 4000000. | 0.00 | 225.0000 | 0.1923 | 0.0179 | 0.1887 | -0.0324 |
| 4000000. | 0.00 | 240.0000 | 0.1924 | 0.0311 | 0.1871 | -0.0322 |
| 4000000. | 0.00 | 255.0000 | 0.1934 | 0.0472 | 0.1850 | -0.0306 |
| 4000000. | 0.00 | 270.0000 | 0.1945 | 0.0661 | 0.1814 | -0.0238 |
| 4000000. | 0.00 | 285.0000 | 0.1935 | 0.0808 | 0.1757 | -0.0065 |
| 4000000. | 0.00 | 300.0000 | 0.1871 | 0.0791 | 0.1685 | 0.0184 |
| 4000000. | 0.00 | 315.0000 | 0.1773 | 0.0571 | 0.1628 | 0.0411 |
| 4000000. | 0.00 | 330.0000 | 0.1695 | 0.0199 | 0.1593 | 0.0543 |
| 4000000. | 0.00 | 345.0000 | 0.1690 | -0.0218 | 0.1593 | 0.0520 |
| 4000000. | 10.00 | 0. | 0.1823 | 0.0134 | 0.1788 | 0.0327 |
| 4000000. | 10.00 | 15.0000 | 0.1870 | 0.0060 | 0.1860 | 0.0182 |
| 4000000. | 10.00 | 30.0000 | 0.1926 | 0.0077 | 0.1923 | 0.0086 |
| 4000000. | 10.00 | 45.0000 | 0.1991 | 0.0130 | 0.1986 | 0.0055 |
| 4000000. | 10.00 | 60.0000 | 0.2073 | 0.0159 | 0.2065 | 0.0079 |
| 4000000. | 10.00 | 75.0000 | 0.2162 | 0.0122 | 0.2156 | 0.0 01 |
| 4000000. | 10.00 | 90.0000 | 0.2233 | 0.0070 | 0.2231 | 0.0065 |
| 4000000. | 10.00 | 105.0000 | 0.2253 | 0.0081 | 0.2251 | -0.0011 |
| 4000000. | 10.00 | 120.0000 | 0.2222 | 0.0142 | 0.2217 | -0.0055 |
| 4000000. | 10.00 | 135.0000 | 0.2156 | 0.0184 | 0.2146 | -0.0081 |
| 4000000. | 10.00 | 150.0000 | 0.2078 | 0.0218 | 0.2061 | -0.0140 |
| 4000000. | 10.00 | 165.0000 | 0.2015 | 0.0306 | 0.1979 | -0.0228 |
| 4000000. | 10.00 | 180.0000 | 0.1981 | 0.0442 | 0.1910 | -0.0285 |
| 4000000. | 10.00 | 195.0000 | 0.1979 | 0.0586 | 0.1864 | -0.0314 |
| 4000000. | 10.00 | 210.0000 | 0.2005 | 0.0719 | 0.1844 | -0.0320 |
| 4000000. | 10.00 | 225.0000 | 0.2053 | 0.0848 | 0.1841 | -0.0323 |
| 4000000. | 10.00 | 240.0000 | 0.2114 | 0.0992 | 0.1839 | -0.0320 |
| 4000000. | 10.00 | 255.0000 | 0.2180 | 0.1159 | 0.1823 | -0.0293 |
| 4000000. | 10.00 | 270.0000 | 0.2239 | 0.1340 | 0.1781 | -0.0207 |
| 4000000. | 10.00 | 285.0000 | 0.2250 | 0.1458 | 0.1713 | -0.0018 |
| 4000000. | 10.00 | 300.0000 | 0.2173 | 0.1397 | 0.1649 | 0.0227 |
| 4000000. | 10.00 | 315.0000 | 0.2036 | 0.1152 | 0.1622 | 0.0434 |
| 4000000. | 10.00 | 330.0000 | 0.1895 | 0.0774 | 0.1641 | 0.0545 |
| 4000000. | 10.00 | 345.0000 | 0.1814 | 0. 373 | 0.1705 | 0.0493 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 4000000. | 20.00 | 0. | 0.2020 | 0.0851 | 0.1809 | 0.0286 |
| 4000000. | 20.00 | 15.0000 | 0.2044 | 0.0806 | 0.1873 | 0.0149 |
| 4000000. | 20.00 | 30.0000 | 0.2100 | 0.0844 | 0.1922 | 0.0051 |
| 4000000. | 20.00 | 45.0000 | 0.2170 | 0.0918 | 0.1975 | 0.0013 |
| 4000000. | 20.00 | 60.0000 | 0.2265 | 0.0979 | 0.2042 | 0.0025 |
| 4000000. | 20.00 | 75.0000 | 0.2341 | 0.0992 | 0.2120 | 0.0046 |
| 4000000. | 20.00 | 90.0000 | 0.2392 | 0.0978 | 0.2182 | 0.0037 |
| 4000000. | 20.00 | 105.0000 | 0.2399 | 0.0976 | 0.2191 | 0.0002 |
| 4000000. | 20.00 | 120.0000 | 0.2359 | 0.0989 | 0.2142 | -0.0011 |
| 4000000. | 20.00 | 135.0000 | 0.2271 | 0.0960 | 0.2058 | -0.0021 |
| 4000000. | 20.00 | 150.0000 | 0.2170 | 0.0924 | 0.1962 | -0.0080 |
| 4000000. | 20.00 | 165.0000 | 0.2101 | 0.0952 | 0.1864 | -0.0177 |
| 4000000. | 20.00 | 180.0000 | 0.2087 | 0.1050 | 0.1786 | -0.0257 |
| 4000000. | 20.00 | 195.0000 | 0.2127 | 0.1182 | 0.1741 | -0.0307 |
| 4000000. | 20.00 | 210.0000 | 0.2202 | 0.1328 | 0.1725 | -0.0332 |
| 4000000. | 20.00 | 225.0000 | 0.2304 | 0.1486 | 0.1726 | -0.0342 |
| 4000000. | 20.00 | 240.0000 | 0.2417 | 0.1659 | 0.1727 | -0.0331 |
| 4000000. | 20.00 | 255.0000 | 0.2525 | 0.1840 | 0.1705 | -0.0284 |
| 4000000. | 20.00 | 270.0000 | 0.2602 | 0.2007 | 0.1648 | -0.0170 |
| 4000000. | 20.00 | 285.0000 | 0.2605 | 0.2076 | 0.1573 | 0.0033 |
| 4000000. | 20.00 | 300.0000 | 0.2506 | 0.1971 | 0.1525 | 0.0264 |
| 4000000. | 20.00 | 315.0000 | 0.2341 | 0.1714 | 0.1531 | 0.0443 |
| 4000000. | 20.00 | 330.0000 | 0.2164 | 0.1362 | 0.1600 | 0.0519 |
| 4000000. | 20.00 | 345.0000 | 0.2048 | 0.1030 | 0.1713 | 0.0445 |
| 4000000. | 30.00 | 0. | 0.2301 | 0.1545 | 0.1687 | 0.0253 |
| 4000000. | 30.00 | 15.0000 | 0.2315 | 0.1517 | 0.1744 | 0.0125 |
| 4000000. | 30.00 | 30.0000 | 0.2370 | 0.1564 | 0.1780 | 0.0023 |
| 4000000. | 30.00 | 45.0000 | 0.2457 | 0.1654 | 0.1817 | -0.0025 |
| 4000000. | 30.00 | 60.0000 | 0.2554 | 0.1744 | 0.1866 | -0.0024 |
| 4000000. | 30.00 | 75.0000 | 0.2633 | 0.1795 | 0.1926 | -0.0003 |
| 4000000. | 30.00 | 90.0000 | 0.2684 | 0.1814 | 0.1978 | 0.0010 |
| 4000000. | 30.00 | 105.0000 | 0.2693 | 0.1812 | 0.1992 | 0.0018 |
| 4000000. | 30.00 | 120.0000 | 0.2641 | 0.1775 | 0.1956 | 0.0038 |
| 4000000. | 30.00 | 135.0000 | 0.2535 | 0.1684 | 0.1894 | 0.0041 |
| 4000000. | 30.00 | 150.0000 | 0.2410 | 0.1583 | 0.1817 | -0.0015 |
| 4000000. | 30.00 | 165.0000 | 0.2323 | 0.1544 | 0.1731 | -0.0121 |
| 4000000. | 30.00 | 180.0000 | 0.2307 | 0.1594 | 0.1652 | -0.0229 |
| 4000000. | 30.00 | 195.0000 | 0.2366 | 0.1718 | 0.1598 | -0.0307 |
| 4000000. | 30.00 | 210.0000 | 0.2472 | 0.1879 | 0.1568 | -0.0352 |
| 4000000. | 30.00 | 225.0000 | 0.2612 | 0.2068 | 0.1552 | -0.0368 |
| 4000000. | 30.00 | 240.0000 | 0.2759 | 0.2271 | 0.1529 | -0.0346 |
| 4000000. | 30.00 | 255.0000 | 0.2888 | 0.2461 | 0.1486 | -0.0272 |
| 4000000. | 30.00 | 270.0000 | 0.2961 | 0.2597 | 0.1417 | -0.0126 |
| 4000000. | 30.00 | 285.0000 | 0.2942 | 0.2612 | 0.1351 | 0.0081 |
| 4000000. | 30.00 | 300.0000 | 0.2826 | 0.2477 | 0.1330 | 0.0292 |
| 4000000. | 30.00 | 315.0000 | 0.2649 | 0.2223 | 0.1372 | 0.0438 |
| 4000000. | 30.00 | 330.0000 | 0.2468 | 0.1921 | 0.1474 | 0.0475 |
| 4000000. | 30.00 | 345.0000 | 0.2349 | 0.1676 | 0.1597 | 0.0396 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 4000000. | 40.00 | 0. | 0.2590 | 0.2126 | 0.1461 | 0.0229 |
| 4000000. | 40.00 | 15.0000 | 0.2599 | 0.2112 | 0.1510 | 0.0105 |
| 4000000. | 40.00 | 30.0000 | 0.2653 | 0.2162 | 0.1537 | 0.0004 |
| 4000000. | 40.00 | 45.0000 | 0.2741 | 0.2257 | 0.1555 | -0.0055 |
| 4000000. | 40.00 | 60.0000 | 0.2848 | 0.2366 | 0.1582 | -0.0068 |
| 4000000. | 40.00 | 75.0000 | 0.2939 | 0.2450 | 0.1623 | -0.0059 |
| 4000000. | 40.00 | 90.0000 | 0.3006 | 0.2504 | 0.1664 | -0.0021 |
| 4000000. | 40.00 | 105.0000 | 0.3026 | 0.2515 | 0.1683 | 0.0024 |
| 4000000. | 40.00 | 120.0000 | 0.2973 | 0.2453 | 0.1677 | 0.0073 |
| 4000000. | 40.00 | 135.0000 | .2856 | 0.2326 | 0.1655 | 0.0091 |
| 4000000. | 40.00 | 150.0000 | .2717 | 0.2181 | 0.1620 | 0.0039 |
| 4000000. | 40.00 | 165.00 | 0.2620 | 0.2097 | 0.1568 | -0.0072 |
| 4000000. | 40.00 | 180.0000 | 0.2597 | 0.2109 | 0.1502 | -0.0200 |
| 4000000. | 40.00 | 195.0000 | 0.2657 | 0.2215 | 0.1437 | -0.0303 |
| 4000000. | 40.00 | 210.0000 | 0.2774 | 0.2378 | 0.1380 | -0.0366 |
| 4000000. | 40.00 | 225.0000 | 0.2926 | 0.2580 | 0.1326 | -0.0385 |
| 4000000. | 40.00 | 240.0000 | 0.3078 | 0.2785 | 0.1253 | -0.0348 |
| 4000000. | 40.00 | 255.0000 | 0.3201 | 0.2962 | 0.1188 | -0.0247 |
| 4000000. | 40.00 | 270.0000 | 0.3252 | 0.3056 | 0.1111 | -0.0081 |
| 4000000. | 40.00 | 285.0000 | 0.3215 | 0.3030 | 0.1066 | 0.0121 |
| 4000000. | 40.00 | 300.0000 | 0.3091 | 0.2880 | 0.1079 | 0.0307 |
| 4000000. | 40.00 | 315.0000 | 0.2923 | 0.2653 | 0.1153 | 0.0418 |
| 4000000. | 40.00 | 330.0000 | 0.2763 | 0.2418 | 0.1268 | 0.0429 |
| 4000000. | 40.00 | 345.0000 | 0.2649 | 0.2233 | 0.1380 | 0.0357 |
| 4000000. | 50.00 | 0. | 0.2846 | 0.2575 | 0.1194 | 0.0208 |
| 4000000. | 50.00 | 15.0000 | 0.2853 | 0.2569 | 0.1238 | 0.0091 |
| 4000000. | 50.00 | 30.0000 | 0.2902 | 0.2618 | 0.1253 | -0.0007 |
| 4000000. | 50.00 | 45.0000 | 0.2984 | 0.2707 | 0.1253 | -0.0076 |
| 4000000. | 50.00 | 60.0000 | 0.3089 | 0.2821 | 0.1254 | -0.0103 |
| 4000000. | 50.00 | 75.0000 | 0.3192 | 0.2928 | 0.1269 | -0.0092 |
| 4000000. | 50.00 | 90.0000 | 0.3271 | 0.3007 | 0.1288 | -0.0051 |
| 4000000. | 50.00 | 105.0000 | 0.3299 | 0.3030 | 0.1306 | 0.0015 |
| 4000000. | 50.00 | 120.0000 | 0.3261 | 0.2977 | 0.1330 | 0.0080 |
| 4000000. | 50.00 | 135.0000 | 0.3164 | 0.2857 | 0.1356 | 0.0109 |
| 4000000. | 50.00 | 150.0000 | 0.3044 | 0.2716 | 0.1372 | 0.0066 |
| 4000000. | 50.00 | 165.0000 | 0.2952 | 0.2621 | 0.1358 | -0.0038 |
| 4000000. | 50.00 | 180.0000 | 0.2917 | 0.2602 | 0.1308 | -0.0168 |
| 4000000. | 50.00 | 195.0000 | 0.2956 | 0.2672 | 0.1231 | -0.0285 |
| 4000000. | 50.00 | 210.0000 | 0.3059 | 0.2814 | 0.1144 | -0.0361 |
| 4000000. | 50.00 | 225.0000 | 0.3196 | 0.2995 | 0.1049 | -0.0378 |
| 4000000. | 50.00 | 240.0000 | 0.3327 | 0.3172 | 0.0948 | -0.0325 |
| 4000000. | 50.00 | 255.0000 | 0.3415 | 0.3302 | 0.0849 | -0.0203 |
| 4000000. | 50.00 | 270.0000 | 0.3432 | 0.3343 | 0.0775 | -0.0034 |
| 4000000. | 50.00 | 285.0000 | 0.3383 | 0.3295 | 0.0754 | 0.0146 |
| 4000000. | 50.00 | 300.0000 | 0.3276 | 0.3162 | 0.0800 | 0.0302 |
| 4000000. | 50.00 | 315.0000 | 0.3133 | 0.2978 | 0.0892 | 0.0389 |
| 4000000. | 50.00 | 330.0000 | 0.2995 | 0.2794 | 0.1004 | 0.0391 |
| 4000000. | 50.00 | 345.0000 | 0.2894 | 0.2652 | 0.1112 | 0.0322 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 4000000. | 60.00 | 0. | 0.3058 | 0.2910 | 0.0922 | 0.0189 |
| 4000000. | 60.00 | 15.0000 | 0.3064 | 0.2908 | 0.0959 | 0.0086 |
| 4000000. | 60.00 | 30.0000 | 0.3101 | 0.2947 | 0.0966 | -0.0008 |
| 4000000. | 60.00 | 45.0000 | 0.3165 | 0.3017 | 0.0951 | -0.0080 |
| 4000000. | 60.00 | 60.0000 | 0.3252 | 0.3114 | 0.0928 | -0.0123 |
| 4000000. | 60.00 | 75.0000 | 0.3354 | 0.3225 | 0.0913 | -0.0125 |
| 4000000. | 60.00 | 90.0000 | 0.3440 | 0.3317 | 0.0911 | -0.0083 |
| 4000000. | 60.00 | 105.0000 | 0.3481 | 0.3356 | 0.0927 | -0.0013 |
| 4000000. | 60.00 | 120.0000 | 0.3469 | 0.3332 | 0.0962 | 0.0054 |
| 4000000. | 60.00 | 135.0000 | 0.3407 | 0.3253 | 0.1008 | 0.0089 |
| 4000000. | 60.00 | 150.0000 | 0.3319 | 0.3148 | 0.1049 | 0.0061 |
| 4000000. | 60.00 | 165.0000 | 0.3244 | 0.3065 | 0.1062 | -0.0025 |
| 4000000. | 60.00 | 180.0000 | 0.3210 | 0.3035 | 0.1036 | -0.0139 |
| 4000000 | 60.00 | 195.0000 | 0.3229 | 0.3070 | 0.0967 | -0.0250 |
| 4000000. | 60.00 | 210.0000 | 0.3297 | 0.3165 | 0.0864 | -0.0324 |
| 4000000. | 60.00 | 225.0000 | 0.3390 | 0.3291 | 0.0741 | -0.0333 |
| 4000000. | 60.00 | 240.0000 | 0.3475 | 0.3409 | 0.0621 | -0.0272 |
| 4000000. | 60.00 | 255.0000 | 0.3522 | 0.3480 | 0.0526 | -0.0147 |
| 4000000. | 60.00 | 270.0000 | 0.3514 | 0.3481 | 0.0474 | 0.0008 |
| 4000000. | 60.00 | 285.0000 | 0.3461 | 0.3425 | 0.0476 | 0.0159 |
| 4000000. | 60.00 | 300.0000 | 0.3379 | 0.3324 | 0.0532 | 0.0283 |
| 4000000. | 60.00 | 315.0000 | 0.3272 | 0.3191 | 0.0630 | 0.0354 |
| 4000000. | 60.00 | 330.0000 | 0.3164 | 0.3055 | 0.0745 | 0.0352 |
| 4000000. | 60.00 | 345.0000 | 0.3090 | 0.2957 | 0.0849 | 0.0286 |
| 4000000. | 70.00 | 0. | 0.3231 | 0.3158 | 0.0659 | 0.0175 |
| 4000000. | 70.00 | 15.0000 | 0.3233 | 0.3157 | 0.0694 | 0.0087 |
| 4000000. | 70.00 | 30.0000 | 0.3256 | 0.3180 | 0.0699 | 0.0003 |
| 4000000. | 70.00 | 45.0000 | 0.3298 | 0.3226 | 0.0681 | -0.0068 |
| 4000000. | 70.00 | 60.0000 | 0.3359 | 0.3294 | 0.0647 | -0.0118 |
| 4000000. | 70.00 | 75.0000 | 0.3435 | 0.3378 | 0.0608 | -0.0135 |
| 4000000. | 70.00 | 90.0000 | 0.3508 | 0.3458 | 0.0578 | -0.0110 |
| 4000000. | 70.00 | 105.0000 | 0.3556 | 0.3509 | 0.0572 | -0.0057 |
| 4000000. | 70.00 | 120.0000 | 0.356[illegible] | 0.3516 | 0.0594 | 0.0000 |
| 4000000. | 70.00 | 135.0000 | 0.3541 | 0.3483 | 0.0637 | 0.0033 |
| 4000000. | 70.00 | 150.0000 | 0.3494 | 0.3427 | 0.0682 | 0.0019 |
| 4000000. | 70.00 | 165.0000 | 0.3451 | 0.3378 | 0.0705 | -0.0040 |
| 4000000. | 70.00 | 180.0000 | 0.3428 | 0.3356 | 0.0690 | -0.0123 |
| 4000000. | 70.00 | 195.0000 | 0.3432 | 0.3367 | 0.0632 | -0.0201 |
| 4000000. | 70.00 | 210.0000 | 0.3458 | 0.3407 | 0.0539 | -0.0250 |
| 4000000. | 70.00 | 225.0000 | 0.3497 | 0.3461 | 0.0428 | -0.0250 |
| 4000000. | 70.00 | 240.0000 | 0.3533 | 0.3513 | 0.0323 | -0.0194 |
| 4000000. | 70.00 | 255.0000 | 0.3550 | 0.3540 | 0.0248 | -0.0089 |
| 4000000. | 70.00 | 270.0000 | 0.3536 | 0.3529 | 0.0220 | 0.0039 |
| 4000000. | 70.00 | 285.0000 | 0.3493 | 0.3481 | 0.0240 | 0.0162 |
| 4000000. | 70.00 | 300.0000 | 0.3431 | 0.3408 | 0.0303 | 0.0256 |
| 4000000. | 70.00 | 315.0000 | 0.3361 | 0.3323 | 0.0397 | 0.0306 |
| 4000000. | 70.00 | 330.0000 | 0.3297 | 0.3244 | 0.0501 | 0.0302 |
| 4000000. | 70.00 | 345.0000 | 0.3252 | 0.3187 | 0.0594 | 0.0252 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 4000000. | 80.00 | 0. | 0.3379 | 0.3352 | 0.0395 | 0.0159 |
| 4000000. | 80.00 | 15.0000 | 0.3381 | 0.3352 | 0.0429 | 0.0093 |
| 4000000. | 80.00 | 30.0000 | 0.3393 | 0.3364 | 0.0439 | 0.0026 |
| 4000000. | 80.00 | 45.0000 | 0.3414 | 0.3387 | 0.0427 | -0.0036 |
| 4000000. | 80.00 | 60.0000 | 0.3443 | 0.3419 | 0.0398 | -0.0082 |
| 4000000. | 80.00 | 75.0000 | 0.3477 | 0.3457 | 0.0360 | -0.0107 |
| 4000000. | 80.00 | 90.0000 | 0.3509 | 0.3493 | 0.0323 | -0.0109 |
| 4000000. | 80.00 | 105.0000 | 0.3535 | 0.3522 | 0.0298 | -0.0094 |
| 4000000. | 80.00 | 120.0000 | 0.3550 | 0.3538 | 0.0290 | -0.0073 |
| 4000000. | 80.00 | 135.0000 | 0.3553 | 0.3540 | 0.0297 | -0.0060 |
| 4000000. | 80.00 | 150.0000 | 0.3547 | 0.3533 | 0.0308 | -0.0064 |
| 4000000. | 80.00 | 165.0000 | 0.3538 | 0.3523 | 0.0310 | -0.0086 |
| 4000000. | 80.00 | 180.0000 | 0.3529 | 0.3515 | 0.0293 | -0.0118 |
| 4000000. | 80.00 | 195.0000 | 0.3525 | 0.3513 | 0.0253 | -0.0147 |
| 4000000. | 80.00 | 210.0000 | 0.3524 | 0.3516 | 0.0194 | -0.0158 |
| 4000000. | 80.00 | 225.0000 | 0.3526 | 0.3521 | 0.0127 | -0.0142 |
| 4000000. | 80.00 | 240.0000 | 0.3527 | 0.3525 | 0.0067 | -0.0095 |
| 4000000. | 80.00 | 255.0000 | 0.3522 | 0.3522 | 0.0027 | -0.0022 |
| 4000000. | 80.00 | 270.0000 | 0.3509 | 0.3509 | 0.0020 | 0.0063 |
| 4000000. | 80.00 | 285.0000 | 0.3487 | 0.3484 | 0.0048 | 0.0146 |
| 4000000. | 80.00 | 300.0000 | 0.3460 | 0.3452 | 0.0105 | 0.0209 |
| 4000000. | 80.00 | 315.0000 | 0.3431 | 0.3417 | 0.0182 | 0.0242 |
| 4000000. | 80.00 | 330.0000 | 0.3405 | 0.3386 | 0.0264 | 0.0242 |
| 4000000. | 80.00 | 345.0000 | 0.3387 | 0.3363 | 0.0338 | 0.0212 |
| 4000000. | 90.00 | 0. | 0.3496 | 0.3492 | 0 | 0 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 5000000. | -90.00 | 0. | 0.3020 | -0.2951 | 0 | 0 |
| 5000000. | -80.00 | 0. | 0.2775 | -0.2662 | 0.0681 | 0.0390 |
| 5000000. | -80.00 | 15.0000 | 0.2810 | -0.2707 | 0.0571 | 0.0490 |
| 5000000. | -80.00 | 30.0000 | 0.2855 | -0.2764 | 0.0443 | 0.0561 |
| 5000000. | -80.00 | 45.0000 | 0.2909 | -0.2830 | 0.0303 | 0.0600 |
| 5000000. | -80.00 | 60.0000 | 0.2968 | -0.2902 | 0.0157 | 0.0605 |
| 5000000. | -80.00 | 75.0000 | 0.3032 | -0.2977 | 0.0012 | 0.0574 |
| 5000000. | -80.00 | 90.0000 | 0.3096 | -0.3052 | -0.0123 | 0.0504 |
| 5000000. | -80.00 | 105.0000 | 0.3155 | -0.3121 | -0.0239 | 0.0399 |
| 5000000. | -80.00 | 120.0000 | 0.3206 | -0.3179 | -0.0325 | 0.0262 |
| 5000000. | -80.00 | 135.0000 | 0.3244 | -0.3220 | -0.0374 | 0.0102 |
| 5000000. | -80.00 | 150.0000 | 0.3265 | -0.3242 | -0.0380 | -0.0069 |
| 5000000. | -80.00 | 165.0000 | 0.3268 | -0.3241 | -0.0342 | -0.0240 |
| 5000000. | -80.00 | 180.0000 | 0.3248 | -0.3213 | -0.0260 | -0.0398 |
| 5000000. | -80.00 | 195.0000 | 0.3208 | -0.3161 | -0.0140 | -0.0528 |
| 5000000. | -80.00 | 210.0000 | 0.3149 | -0.3088 | 0.0010 | -0.0618 |
| 5000000. | -80.00 | 225.0000 | 0.3078 | -0.3001 | 0.0176 | -0.0660 |
| 5000000. | -80.00 | 240.0000 | 0.3001 | -0.2909 | 0.0345 | -0.0652 |
| 5000000. | -80.00 | 255.0000 | 0.2927 | -0.2821 | 0.0504 | -0.0595 |
| 5000000. | -80.00 | 270.0000 | 0.2862 | -0.2745 | 0.0642 | -0.0495 |
| 5000000. | -80.00 | 285.0000 | 0.2810 | -0.2684 | 0.0747 | -0.0361 |
| 5000000. | -80.00 | 300.0000 | 0.2773 | -0.2643 | 0.0813 | -0.0207 |
| 5000000. | -80.00 | 315.0000 | 0.2751 | -0.2620 | 0.0837 | -0.0044 |
| 5000000. | -80.00 | 330.0000 | 0.2745 | -0.2617 | 0.0820 | 0.0116 |
| 5000000. | -80.00 | 345.0000 | 0.2753 | -0.2631 | 0.0767 | 0.0263 |
| 5000000. | -70.00 | 0. | 0.2496 | -0.2331 | 0.0805 | 0.0384 |
| 5000000. | -70.00 | 15.0000 | 0.2561 | -0.2416 | 0.0708 | 0.0466 |
| 5000000. | -70.00 | 30.0000 | 0.2645 | -0.2521 | 0.0605 | 0.0523 |
| 5000000. | -70.00 | 45.0000 | 0.2743 | -0.2640 | 0.0495 | 0.0557 |
| 5000000. | -70.00 | 60.0000 | 0.2853 | -0.2770 | 0.0379 | 0.0567 |
| 5000000. | -70.00 | 75.0000 | 0.2972 | -0.2910 | 0.0260 | 0.0548 |
| 5000000. | -70.00 | 90.0000 | 0.3096 | -0.3054 | 0.0144 | 0.0489 |
| 5000000. | -70.00 | 105.0000 | 0.3212 | -0.3186 | 0.0046 | 0.0386 |
| 5000000. | -70.00 | 120.0000 | 0.3306 | -0.3297 | -0.0020 | 0.0247 |
| 5000000. | -70.00 | 135.0000 | 0.3373 | -0.3371 | -0.0045 | 0.0088 |
| 5000000. | -70.00 | 150.0000 | 0.3412 | -0.3411 | -0.0031 | -0.0078 |
| 5000000. | -70.00 | 165.0000 | 0.3419 | -0.3410 | 0.0021 | -0.0246 |
| 5000000. | -70.00 | 180.0000 | 0.3383 | -0.3357 | 0.0108 | -0.0402 |
| 5000000. | -70.00 | 195.0000 | 0.3302 | -0.3253 | 0.0223 | -0.0524 |
| 5000000. | -70.00 | 210.0000 | 0.3189 | -0.3112 | 0.0350 | -0.0599 |
| 5000000. | -70.00 | 225.0000 | 0.3058 | -0.2955 | 0.0477 | -0.0629 |
| 5000000. | -70.00 | 240.0000 | 0.2922 | -0.2791 | 0.0602 | -0.0620 |
| 5000000. | -70.00 | 255.0000 | 0.2788 | -0.2630 | 0.0726 | -0.0571 |
| 5000000. | -70.00 | 270.0000 | 0.2666 | -0.2485 | 0.0842 | -0.0476 |
| 5000000. | -70.00 | 285.0000 | 0.2568 | -0.2368 | 0.0934 | -0.0340 |
| 5000000. | -70.00 | 300.0000 | 0.2499 | -0.2289 | 0.0986 | -0.0179 |
| 5000000. | -70.00 | 315.0000 | 0.2457 | -0.2248 | 0.0993 | -0.0012 |
| 5000000. | -70.00 | 330.0000 | 0.2443 | -0.2244 | 0.0957 | 0.0143 |
| 5000000. | -70.00 | 345.0000 | 0.2456 | -0.2272 | 0.0890 | 0.0277 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 5000000. | -60.00 | 0. | 0.2207 | -0.2003 | 0.0847 | 0.0380 |
| 5000000. | -60.00 | 15.0000 | 0.2293 | -0.2115 | 0.077[illegible] | 0.0433 |
| 5000000. | -60.00 | 30.0000 | 0.2403 | -0.2249 | 0.0704 | 0.0473 |
| 5000000. | -60.00 | 45.0000 | 0.2536 | -0.2402 | 0.0638 | 0.0504 |
| 5000000. | -60.00 | 60.0000 | 0.2687 | -0.2575 | 0.0562 | 0.0521 |
| 5000000. | -60.00 | 75.0000 | 0.2852 | -0.2765 | 0.0479 | 0.0511 |
| 5000000. | -60.00 | 90.0000 | 0.3026 | -0.2965 | 0.0398 | 0.0460 |
| 5000000. | -60.00 | 105.0000 | 0.3189 | -0.3152 | 0.0334 | 0.0356 |
| 5000000. | -60.00 | 120.0000 | 0.3315 | -0.3295 | 0.0302 | 0.0208 |
| 5000000. | -60.00 | 135.0000 | 0.3391 | -0.3377 | 0.0312 | 0.0043 |
| 5000000. | -60.00 | 150.0000 | 0.3423 | -0.3402 | 0.0360 | -0.0118 |
| 5000000. | -60.00 | 165.0000 | 0.3411 | -0.3372 | 0.0435 | -0.0272 |
| 5000000. | -60.00 | 180.0000 | 0.3342 | -0.3275 | 0.0526 | -0.0410 |
| 5000000. | -60.00 | 195.0000 | 0.3218 | -0.3116 | 0.0623 | -0.0506 |
| 5000000. | -60.00 | 210.0000 | 0.3068 | -0.2933 | 0.0712 | -0.0551 |
| 5000000. | -60.00 | 225.0000 | 0.2916 | -0.2751 | 0.0790 | -0.0561 |
| 5000000. | -60.00 | 240.0000 | 0.2766 | -0.2568 | 0.0864 | -0.0556 |
| 5000000. | -60.00 | 255.0000 | 0.2607 | -0.2372 | 0.0943 | -0.0527 |
| 5000000. | -60.00 | 270.0000 | 0.2445 | 0.2173 | 0.1026 | -0.0451 |
| 5000000. | -60.00 | 285.0000 | 0.2301 | -0.2000 | 0.1093 | -0.0318 |
| 5000000. | -60.00 | 300.0000 | 0.2197 | -0.1884 | 0.1121 | -0.0144 |
| 5000000. | -60.00 | 315.0000 | 0.2140 | -0.1838 | 0.1095 | 0.0036 |
| 5000000. | -60.00 | 330.0000 | 0.2127 | -0.1853 | 0.1026 | 0.0189 |
| 5000000. | -60.00 | 345.0000 | 0.2151 | -0.1913 | 0.0936 | 0.0302 |
| 5000000. | -50.00 | 0. | 0.1968 | -0.1735 | 0.0848 | 0.0378 |
| 5000000. | -50.00 | 15.0000 | 0.2067 | -0.1869 | 0.0791 | 0.0394 |
| 5000000. | -50.00 | 30.0000 | 0.2185 | -0.2006 | 0.0762 | 0.0412 |
| 5000000. | -50.00 | 45.0000 | 0.2330 | -0.2165 | 0.0741 | 0.0441 |
| 5000000. | -50.00 | 60.0000 | 0.2507 | -0.2358 | 0.0712 | 0.0467 |
| 5000000. | -50.00 | 75.0000 | 0.2709 | -0.2583 | 0.0670 | 0.0465 |
| 5000000. | -50.00 | 90.0000 | 0.2915 | -0.2816 | 0.0630 | 0.0413 |
| 5000000. | -50.00 | 105.0000 | 0.3102 | -0.3025 | 0.0612 | 0.0305 |
| 5000000. | -50.00 | 120.0000 | 0.3238 | -0.3174 | 0.0625 | 0.0153 |
| 5000000. | -50.00 | 135.0000 | 0.3305 | -0.3237 | 0.0669 | -0.0014 |
| 5000000. | -50.00 | 150.0000 | 0.3303 | -0.3215 | 0.0737 | -0.0168 |
| 5000000. | -50.00 | 165.0000 | 0.3249 | -0.3132 | 0.0815 | -0.0298 |
| 5000000. | -50.00 | 180.0000 | 0.3147 | -0.2991 | 0.0889 | -0.0406 |
| 5000000. | -50.00 | 195.0000 | 0.2999 | -0.2804 | 0.0952 | -0.0471 |
| 5000000. | -50.00 | 210.0000 | 0.2837 | -0.2608 | 0.1002 | -0.0594 |
| 5000000. | -50.00 | 225.0000 | 0.2684 | -0.2421 | 0.1046 | -0.0496 |
| 5000000. | -50.00 | 240.0000 | 0.2534 | -0.2235 | 0.1089 | -0.0493 |
| 5000000. | -50.00 | 255.0000 | 0.2370 | -0.2026 | 0.1133 | -0.0476 |
| 5000000. | -50.00 | 270.0000 | 0.2190 | -0.1799 | 0.1177 | -0.0414 |
| 5000000. | -50.00 | 285.0000 | 0.2019 | -0.1594 | 0.1208 | -0.0283 |
| 5000000. | -50.00 | 300.0000 | 0.1895 | -0.1463 | 0.1200 | -0.0096 |
| 5000000. | -50.00 | 315.0000 | 0.1839 | -0.1438 | 0.1142 | 0.0097 |
| 5000000. | -50.00 | 330.0000 | 0.1843 | -0.1498 | 0.1046 | 0.0247 |
| 5000000. | -50.00 | 345.0000 | 0.1891 | -0.1607 | 0.0933 | 0.0337 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 5000000. | -40.00 | 0. | 0.1796 | -0.1533 | 0.0857 | 0.0375 |
| 5000000. | -40.00 | 15.0000 | 0.1899 | -0.1673 | 0.0826 | 0.0352 |
| 5000000. | -40.00 | 30.0000 | 0.2012 | -0.1800 | 0.0828 | 0.0350 |
| 5000000. | -40.00 | 45.0000 | 0.2154 | -0.1947 | 0.0845 | 0.0370 |
| 5000000. | -40.00 | 60.0000 | 0.2337 | -0.2134 | 0.0863 | 0.0402 |
| 5000000. | -40.00 | 75.0000 | 0.2558 | -0.2370 | 0.0871 | 0.0408 |
| 5000000. | -40.00 | 90.0000 | 0.2781 | -0.2614 | 0.0880 | 0.0354 |
| 5000000. | -40.00 | 105.0000 | 0.2968 | -0.2816 | 0.0908 | 0.0239 |
| 5000000. | -40.00 | 120.0000 | 0.3088 | -0.2933 | 0.0960 | 0.0088 |
| 5000000. | -40.00 | 135.0000 | 0.3127 | -0.2954 | 0.1023 | -0.0065 |
| 5000000. | -40.00 | 150.0000 | 0.3092 | -0.2891 | 0.1081 | -0.0200 |
| 5000000. | -40.00 | 165.0000 | 0.3008 | -0.2767 | 0.1137 | -0.0308 |
| 5000000. | -40.00 | 180.0000 | 0.2883 | -0.2598 | 0.1186 | -0.0390 |
| 5000000. | -40.00 | 195.0000 | 0.2728 | -0.2401 | 0.1221 | -0.0431 |
| 5000000. | 40.00 | 210.0000 | 0.2574 | -0.2210 | 0.1244 | -0.0442 |
| 5000000. | -40.00 | 225.0000 | 0.2425 | -0.2023 | 0.1262 | -0.0443 |
| 5000000. | -40.00 | 240.0000 | 0.2276 | -0.1833 | 0.1277 | -0.0438 |
| 5000000. | -40.00 | 255.0000 | 0.2115 | -0.1623 | 0.1288 | -0.0424 |
| 5000000. | -40.00 | 270.0000 | 0.1937 | -0.1392 | 0.1296 | -0.0366 |
| 5000000. | -40.00 | 285.0000 | 0.1766 | -0.1183 | 0.1290 | -0.0235 |
| 5000000. | -40.00 | 300.0000 | 0.1643 | -0.1065 | 0.1251 | -0.0039 |
| 5000000. | -40.00 | 315.0000 | 0.1597 | -0.1077 | 0.1170 | 0.0161 |
| 5000000. | -40.00 | 330.0000 | 0.1625 | -0.1195 | 0.1058 | 0.0308 |
| 5000000. | -40.00 | 345.0000 | 0.1700 | -0.1365 | 0.0941 | 0.0374 |
| 5000000. | -30.00 | 0. | 0.1692 | -0.1369 | 0.0923 | 0.0371 |
| 5000000. | -30.00 | 15.0000 | 0.1785 | -0.1506 | 0.0906 | 0.0310 |
| 5000000. | -30.00 | 30.0000 | 0.1884 | -0.1611 | 0.0933 | 0.0289 |
| 5000000. | -30.00 | 45.0000 | 0.2014 | -0.1732 | 0.0984 | 0.0297 |
| 5000000. | -30.00 | 60.0000 | 0.2179 | -0.1886 | 0.1043 | 0.0327 |
| 5000000. | -30.00 | 75.0000 | 0.2389 | -0.2095 | 0.1097 | 0.0339 |
| 5000000. | -30.00 | 90.0000 | 0.2602 | -0.2317 | 0.1150 | 0.0283 |
| 5000000. | -30.00 | 105.0000 | 0.2768 | -0.2480 | 0.1217 | 0.0166 |
| 5000000. | -30.00 | 120.0000 | 0.2855 | -0.2545 | 0.1293 | 0.0024 |
| 5000000. | -30.00 | 135.0000 | 0.2862 | -0.2519 | 0.1355 | -0.0100 |
| 5000000. | -30.00 | 150.0000 | 0.2812 | -0.2432 | 0.1395 | -0.0211 |
| 5000000. | -30.00 | 165.0000 | 0.2714 | -0.2290 | 0.1424 | -0.0303 |
| 5000000. | -30.00 | 180.0000 | 0.2581 | -0.2107 | 0.1444 | -0.0366 |
| 5000000. | -30.00 | 195.0000 | 0.2433 | -0.1914 | 0.1451 | -0.0393 |
| 5000000. | -30.00 | 210.0000 | 0.2291 | -0.1727 | 0.1452 | -0.0398 |
| 5000000. | -30.00 | 225.0000 | 0.2154 | -0.1546 | 0.1447 | -0.0394 |
| 5000000. | -30.00 | 240.0000 | 0.2019 | -0.1367 | 0.1435 | -0.0386 |
| 5000000. | -30.00 | 255.0000 | 0.1879 | -0.1174 | 0.1419 | -0.0371 |
| 5000000. | -30.00 | 270.0000 | 0.1726 | -0.0960 | 0.1400 | -0.0315 |
| 5000000. | -30.00 | 285.0000 | 0.1580 | -0.0771 | 0.1367 | -0.0183 |
| 5000000. | -30.00 | 300.0000 | 0.1476 | -0.0683 | 0.1309 | 0.0018 |
| 5000000. | -30.00 | 315.0000 | 0.1443 | -0.0741 | 0.1218 | 0.0222 |
| 5000000. | -30.00 | 330.0000 | 0.1486 | -0.0921 | 0.1107 | 0.0364 |
| 5000000. | -30.00 | 345.0000 | 0.1583 | -0.1159 | 0.0997 | 0.0411 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 5000000. | -20.00 | 0. | 0.1628 | -0.1169 | 0.1070 | 0.0368 |
| 5000000. | -20.00 | 15.0000 | 0.1713 | -0.1311 | 0.1069 | 0.0275 |
| 5000000. | -20.00 | 30.0000 | 0.1795 | -0.1389 | 0.1113 | 0.0229 |
| 5000000. | -20.00 | 45.0000 | 0.1897 | -0.1462 | 0.1187 | 0.0223 |
| 5000000. | -20.00 | 60.0000 | 0.2031 | -0.1568 | 0.1266 | 0.0252 |
| 5000000. | -20.00 | 75.0000 | 0.2206 | -0.1730 | 0.1344 | 0.0265 |
| 5000000. | -20.00 | 90.0000 | 0.2387 | -0.1906 | 0.1422 | 0.0210 |
| 5000000. | -20.00 | 105.0000 | 0.2512 | -0.2007 | 0.1507 | 0.0093 |
| 5000000. | -20.00 | 120.0000 | 0.2558 | -0.2008 | 0.1584 | -0.0026 |
| 5000000. | -20.00 | 135.0000 | 0.2540 | -0.1947 | 0.1627 | -0.0120 |
| 5000000. | -20.00 | 150.0000 | 0.2480 | -0.1848 | 0.1642 | -0.0208 |
| 5000000. | -20.00 | 165.0000 | 0.2383 | -0.1702 | 0.1643 | -0.0287 |
| 5000000. | -20.00 | 180.0000 | 0.2262 | -0.1524 | 0.1637 | -0.0338 |
| 5000000. | -20.00 | 195.0000 | 0.2137 | -0.1343 | 0.1624 | -0.0357 |
| 5000000. | -20.00 | 210.0000 | 0.2016 | -0.1169 | 0.1604 | -0.0358 |
| 5000000. | -20.00 | 225.0000 | 0.1905 | -0.1007 | 0.1579 | -0.0350 |
| 5000000. | -20.00 | 240.0000 | 0.1803 | -0.0851 | 0.1553 | -0.0340 |
| 5000000. | -20.00 | 255.0000 | 0.1703 | -0.0681 | 0.1526 | -0.0326 |
| 5000000. | -20.00 | 270.0000 | 0.1597 | -0.0491 | 0.1495 | -0.0269 |
| 5000000. | -20.00 | 285.0000 | 0.1495 | -0.0328 | 0.1453 | -0.0134 |
| 5000000. | -20.00 | 300.0000 | 0.1417 | -0.0277 | 0.1387 | 0.0071 |
| 5000000. | -20.00 | 315.0000 | 0.1384 | -0.0385 | 0.1300 | 0.0275 |
| 5000000. | -20.00 | 330.0000 | 0.1416 | -0.0622 | 0.1204 | 0.0411 |
| 5000000. | -20.00 | 345.0000 | 0.1513 | -0.0918 | 0.1119 | 0.0440 |
| | | | | | | |
| 5000000. | -10.00 | 0. | 0.1572 | -0.0857 | 0.1269 | 0.0356 |
| 5000000. | -10.00 | 15.0000 | 0.1652 | -0.0996 | 0.1295 | 0.0242 |
| 5000000. | -10.00 | 30.0000 | 0.1716 | -0.1047 | 0.1349 | 0.0173 |
| 5000000. | -10.00 | 45.0000 | 0.1789 | -0.1069 | 0.1425 | 0.0158 |
| 5000000. | -10.00 | 60.0000 | 0.1893 | -0.1128 | 0.1509 | 0.0185 |
| 5000000. | -10.00 | 75.0000 | 0.2029 | -0.1242 | 0.1592 | 0.0198 |
| 5000000. | -10.00 | 90.0000 | 0.2166 | -0.1366 | 0.1674 | 0.0145 |
| 5000000. | -10.00 | 105.0000 | 0.2245 | -0.1407 | 0.1749 | 0.0036 |
| 5000000. | -10.00 | 120.0000 | 0.2254 | -0.1357 | 0.1799 | -0.0058 |
| 5000000. | -10.00 | 135.0000 | 0.2220 | -0.1277 | 0.1812 | -0.0123 |
| 5000000. | -10.00 | 150.0000 | 0.2160 | -0.1183 | 0.1797 | -0.0193 |
| 5000000. | -10.00 | 165.0000 | 0.2077 | -0.1049 | 0.1773 | -0.0264 |
| 5000000. | -10.00 | 180.0000 | 0.1981 | -0.0882 | 0.1746 | -0.0310 |
| 5000000. | -10.00 | 195.0000 | 0.1889 | -0.0717 | 0.1717 | -0.0324 |
| 5000000. | -10.00 | 210.0000 | 0.1807 | -0.0567 | 0.1685 | -0.0322 |
| 5000000. | -10.00 | 225.0000 | 0.1739 | -0.0431 | 0.1655 | -0.0315 |
| 5000000. | -10.00 | 240.0000 | 0.1684 | -0.0296 | 0.1629 | -0.0307 |
| 5000000. | -10.00 | 255.0000 | 0.1636 | -0.0144 | 0.1603 | -0.0291 |
| 5000000. | -10.00 | 270.0000 | 0.1589 | 0.0028 | 0.1571 | -0.0232 |
| 5000000. | -10.00 | 285.0000 | 0.1538 | 0.0168 | 0.1526 | -0.0091 |
| 5000000. | -10.00 | 300.0000 | 0.1478 | 0.0184 | 0.1462 | 0.0119 |
| 5000000. | -10.00 | 315.0000 | 0.1426 | 0.0031 | 0.1389 | 0.0320 |
| 5000000. | -10.00 | 330.0000 | 0.1417 | -0.0254 | 0.1321 | 0.0445 |
| 5000000. | -10.00 | 345.0000 | 0.1477 | -0.0590 | 0.1275 | 0.0454 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 5000000. | 0.00 | 0. | 0.1547 | -0.0408 | 0.1455 | 0.0329 |
| 5000000. | 0.00 | 15.0000 | 0.1609 | -0.0521 | 0.1508 | 0.0207 |
| 5000000. | 0.00 | 30.0000 | 0.1663 | -0.0544 | 0.1567 | 0.0126 |
| 5000000. | 0.00 | 45.0000 | 0.1720 | -0.0529 | 0.1634 | 0.0103 |
| 5000000. | 0.00 | 60.0000 | 0.1801 | -0.0544 | 0.1712 | 0.0127 |
| 5000000. | 0.00 | 75.0000 | 0.1902 | -0.0617 | 0.1794 | 0.0140 |
| 5000000. | 0.00 | 90.0000 | 0.1996 | -0.0657 | 0.1868 | 0.0094 |
| 5000000. | 0.00 | 105.0000 | 0.2040 | -0.0701 | 0.1915 | 0.0004 |
| 5000000. | 0.00 | 120.0000 | 0.2027 | -0.0634 | 0.1924 | -0.0064 |
| 5000000. | 0.00 | 135.0000 | 0.1983 | -0.0562 | 0.1899 | -0.0107 |
| 5000000. | 0.00 | 150.0000 | 0.1925 | -0.0489 | 0.1854 | -0.0166 |
| 5000000. | 0.00 | 165.0000 | 0.1860 | -0.0376 | 0.1806 | -0.0237 |
| 5000000. | 0.00 | 180.0000 | 0.1798 | -0.0229 | 0.1761 | -0.0281 |
| 5000000. | 0.00 | 195.0000 | 0.1752 | -0.0084 | 0.1724 | -0.0297 |
| 5000000. | 0.00 | 210.0000 | 0.1722 | 0.0045 | 0.1696 | -0.0298 |
| 5000000. | 0.00 | 225.0000 | 0.1708 | 0.0163 | 0.1674 | -0.0294 |
| 5000000. | 0.00 | 240.0000 | 0.1707 | 0.0287 | 0.1658 | -0.0289 |
| 5000000. | 0.00 | 255.0000 | 0.1716 | 0.0434 | 0.1638 | -0.0269 |
| 5000000. | 0.00 | 270.0000 | 0.1725 | 0.0596 | 0.1606 | -0.0203 |
| 5000000. | 0.00 | 285.0000 | 0.1714 | 0.0717 | 0.1556 | -0.0052 |
| 5000000. | 0.00 | 300.0000 | 0.1659 | 0.0699 | 0.1496 | 0.0160 |
| 5000000. | 0.00 | 315.0000 | 0.1574 | 0.0510 | 0.1446 | 0.0353 |
| 5000000. | 0.00 | 330.0000 | 0.1504 | 0.0194 | 0.1417 | 0.0465 |
| 5000000. | 0.00 | 345.0000 | 0.1496 | -0.0158 | 0.1418 | 0.0449 |
| 5000000. | 10.00 | 0. | 0.1610 | 0.0153 | 0.1576 | 0.0294 |
| 5000000. | 10.00 | 15.0000 | 0.1647 | 0.0078 | 0.1637 | 0.0171 |
| 5000000. | 10.00 | 30.0000 | 0.1696 | 0.0083 | 0.1691 | 0.0089 |
| 5000000. | 10.00 | 45.0000 | 0.1753 | 0.0121 | 0.1748 | 0.0060 |
| 5000000. | 10.00 | 60.0000 | 0.1823 | 0.0140 | 0.1817 | 0.0075 |
| 5000000. | 10.00 | 75.0000 | 0.1899 | 0.0109 | 0.1894 | 0.0089 |
| 5000000. | 10.00 | 90.0000 | 0.1960 | 0.0066 | 0.1958 | 0.0059 |
| 5000000. | 10.00 | 105.0000 | 0.1980 | 0.0071 | 0.1979 | -0.0004 |
| 5000000. | 10.00 | 120.0000 | 0.1958 | 0.0117 | 0.1954 | -0.0046 |
| 5000000. | 10.00 | 135.0000 | 0.1905 | 0.0152 | 0.1897 | -0.0073 |
| 5000000. | 10.00 | 150.0000 | 0.1842 | 0.0185 | 0.1828 | -0.0127 |
| 5000000. | 10.00 | 165.0000 | 0.1789 | 0.0262 | 0.1759 | -0.0202 |
| 5000000. | 10.00 | 180.0000 | 0.1761 | 0.0381 | 0.1700 | -0.0254 |
| 5000000. | 10.00 | 195.0000 | 0.1760 | 0.0511 | 0.1660 | -0.0281 |
| 5000000. | 10.00 | 210.0000 | 0.1782 | 0.0634 | 0.1640 | -0.0289 |
| 5000000. | 10.00 | 225.0000 | 0.1823 | 0.0756 | 0.1633 | -0.0291 |
| 5000000. | 10.00 | 240.0000 | 0.1876 | 0.0888 | 0.1627 | -0.0285 |
| 5000000. | 10.00 | 255.0000 | 0.1932 | 0.1038 | 0.161[illegible] | -0.0256 |
| 5000000. | 10.00 | 270.0000 | 0.1980 | 0.1192 | 0.1571 | -0.0176 |
| 5000000. | 10.00 | 285.0000 | 0.1986 | 0.1286 | 0.1513 | -0.0012 |
| 5000000. | 10.00 | 300.0000 | 0.1920 | 0.1231 | 0.1460 | 0.0196 |
| 5000000. | 10.00 | 315.0000 | 0.1803 | 0.1022 | 0.1439 | 0.0373 |
| 5000000. | 10.00 | 330.0000 | 0.1682 | 0.0701 | 0.1456 | 0.0466 |
| 5000000. | 10.00 | 345.0000 | 0.1609 | 0.0364 | 0.1508 | 0.0426 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 5000000. | 20.00 | 0. | 0.1788 | 0.0775 | 0.1591 | 0.0260 |
| 5000000. | 20.00 | 15.0000 | 0.1806 | 0.0726 | 0.1647 | 0.0143 |
| 5000000. | 20.00 | 30.0000 | 0.1851 | 0.0750 | 0.1692 | 0.0058 |
| 5000000. | 20.00 | 45.0000 | 0.1917 | 0.0807 | 0.1738 | 0.0022 |
| 5000000. | 20.00 | 60.0000 | 0.1989 | 0.0855 | 0.1796 | 0.0029 |
| 5000000. | 20.00 | 75.0000 | 0.2053 | 0.0864 | 0.1862 | 0.0043 |
| 5000000. | 20.00 | 90.0000 | 0.2097 | 0.0853 | 0.1915 | 0.0034 |
| 5000000. | 20.00 | 105.0000 | 0.2105 | 0.0852 | 0.1925 | 0.0004 |
| 5000000. | 20.00 | 120.0000 | 0.2074 | 0.0860 | 0.1887 | -0.0011 |
| 5000000. | 20.00 | 135.0000 | 0.2066 | 0.0840 | 0.1822 | -0.0026 |
| 5000000. | 20.00 | 150.0000 | 0.1928 | 0.0817 | 0.1744 | -0.0078 |
| 5000000. | 20.00 | 165.0000 | 0.1873 | 0.0845 | 0.1664 | -0.0160 |
| 5000000. | 20.00 | 180.0000 | 0.1862 | 0.0930 | 0.1597 | -0.0230 |
| 5000000. | 20.00 | 195.0000 | 0.1895 | 0.1047 | 0.1555 | -0.0274 |
| 5000000. | 20.00 | 210.0000 | 0.1959 | 0.1179 | 0.1536 | -0.0297 |
| 5000000. | 20.00 | 225.0000 | 0.2046 | 0.1321 | 0.1532 | -0.0304 |
| 5000000. | 20.00 | 240.0000 | 0.2142 | 0.1475 | 0.1525 | -0.0292 |
| 5000000. | 20.00 | 255.0000 | 0.2233 | 0.1633 | 0.1502 | -0.0247 |
| 5000000. | 20.00 | 270.0000 | 0.2297 | 0.1773 | 0.1453 | -0.0144 |
| 5000000. | 20.00 | 285.0000 | 0.2298 | 0.1828 | 0.1391 | 0.0029 |
| 5000000. | 20.00 | 300.0000 | 0.2215 | 0.1739 | 0.1353 | 0.0226 |
| 5000000. | 20.00 | 315.0000 | 0.2074 | 0.1517 | 0.1360 | 0.0380 |
| 5000000. | 20.00 | 330.0000 | 0.1922 | 0.1220 | 0.1417 | 0.0445 |
| 5000000. | 20.00 | 345.0000 | 0.1819 | 0.0937 | 0.1509 | 0.0389 |
| 5000000. | 30.00 | 0. | 0.2041 | 0.1378 | 0.1488 | 0.0232 |
| 5000000. | 30.00 | 15.0000 | 0.2049 | 0.1347 | 0.1539 | 0.0121 |
| 5000000. | 30.00 | 30.0000 | 0.2093 | 0.1380 | 0.1573 | 0.0034 |
| 5000000. | 30.00 | 45.0000 | 0.2164 | 0.1452 | 0.1605 | -0.0009 |
| 5000000. | 30.00 | 60.0000 | 0.2244 | 0.1523 | 0.1648 | -0.0012 |
| 5000000. | 30.00 | 75.0000 | 0.2310 | 0.1565 | 0.1699 | 0.0002 |
| 5000000. | 30.00 | 90.0000 | 0.2353 | 0.1582 | 0.1742 | 0.0011 |
| 5000000. | 30.00 | 105.0000 | 0.2361 | 0.1580 | 0.1755 | 0.0015 |
| 5000000. | 30.00 | 120.0000 | 0.2321 | 0.1550 | 0.1727 | 0.0026 |
| 5000000. | 30.00 | 135.0000 | 0.2237 | 0.1480 | 0.1677 | 0.0023 |
| 5000000. | 30.00 | 150.0000 | 0.2140 | 0.1404 | 0.1615 | -0.0026 |
| 5000000. | 30.00 | 165.0000 | 0.2072 | 0.1378 | 0.1544 | -0.0115 |
| 5000000. | 30.00 | 180.0000 | 0.2063 | 0.1425 | 0.1477 | -0.0206 |
| 5000000. | 30.00 | 195.0000 | 0.2113 | 0.1535 | 0.1429 | -0.0272 |
| 5000000. | 30.00 | 210.0000 | 0.2203 | 0.1674 | 0.1398 | -0.0310 |
| 5000000. | 30.00 | 225.0000 | 0.2320 | 0.1839 | 0.1377 | -0.0322 |
| 5000000. | 30.00 | 240.0000 | 0.2443 | 0.2012 | 0.1353 | .0301 |
| 5000000. | 30.00 | 255.0000 | 0.2550 | 0.2175 | 0.1311 | -. .0234 |
| 5000000. | 30.00 | 270.0000 | 0.2610 | 0.2288 | 0.1252 | -0.0108 |
| 5000000. | 30.00 | 285.0000 | 0.2595 | 0.2301 | 0.1198 | 0.0068 |
| 5000000. | 30.00 | 300.0000 | 0.2498 | 0.2187 | 0.1183 | 0.0248 |
| 5000000. | 30.00 | 315.0000 | 0.2349 | 0.1972 | 0.1220 | 0.0375 |
| 5000000. | 30.00 | 330.0000 | 0.2195 | 0.1716 | 0.1307 | 0.0411 |
| 5000000. | 30.00 | 345.0000 | 0.2087 | 0.1500 | 0.1409 | 0.0349 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 5000000. | 40.00 | 0. | 0.2305 | 0.1894 | 0.1297 | [illegible]210 |
| 5000000. | 40.00 | 15.0000 | 0.2308 | 0.1875 | 0.1342 | 0.0104 |
| 5000000. | 40.00 | 30.0000 | 0.2351 | 0.1912 | 0.1367 | 0.0017 |
| 5000000. | 40.00 | 45.0000 | 0.2423 | 0.1988 | 0.1385 | -0.0035 |
| 5000000. | 40.00 | 60.0000 | 0.2509 | 0.2076 | 0.1409 | -0.0048 |
| 5000000. | 40.00 | 75.0000 | 0.2584 | 0.2144 | 0.1442 | -0.0035 |
| 5000000. | 40.00 | 90.0000 | 0.2638 | 0.2187 | 0.1474 | -0.0014 |
| 5000000. | 40.00 | 105.0000 | 0.2652 | 0.2195 | 0.1490 | 0.0019 |
| 5000000. | 40.00 | 120.0000 | 0.2611 | 0.2147 | 0.1485 | 0.0054 |
| 5000000. | 40.00 | 135.0000 | 0.2521 | 0.2048 | 0.1468 | 0.0062 |
| 5000000. | 40.00 | 150.0000 | 0.2414 | 0.1938 | 0.1439 | 0.0016 |
| 5000000. | 40.00 | 165.0000 | 0.2339 | 0.1876 | 0.1395 | -0.0076 |
| 5000000. | 40.00 | 180.0000 | 0.2324 | 0.1891 | 0.1339 | -0.0181 |
| 5000000. | 40.00 | 195.0000 | 0.2374 | 0.1981 | 0.1280 | -0.0267 |
| 5000000. | 40.00 | 210.0000 | 0.2471 | 0.2121 | 0.1228 | -0.0319 |
| 5000000. | 40.00 | 225.0000 | 0.2597 | 0.2291 | 0.1177 | -0.0333 |
| 5000000. | 40.00 | 240.0000 | 0.2724 | 0.2465 | 0.1120 | -0.0300 |
| 5000000. | 40.00 | 255.0000 | 0.2825 | 0.2612 | 0.1054 | -0.0212 |
| 5000000. | 40.00 | 270.0000 | 0.2868 | 0.2691 | 0.0990 | -0.0071 |
| 5000000. | 40.00 | 285.0000 | 0.2838 | 0.2672 | 0.0953 | 0.0101 |
| 5000000. | 40.00 | 300.0000 | 0.2737 | 0.2548 | 0.0965 | 0.0260 |
| 5000000. | 40.00 | 315.0000 | 0.2596 | 0.2356 | 0.1028 | 0.0358 |
| 5000000. | 40.00 | 330.0000 | 0.2458 | 0.2154 | 0.1125 | 0.0374 |
| 5000000. | 40.00 | 345.0000 | 0.2357 | 0.1989 | 0.1224 | 0.0315 |
| 5000000. | 50.00 | 0. | 0.2541 | 0.2299 | 0.1066 | 0.0191 |
| 5000000. | 50.00 | 15.0000 | 0.2543 | 0.2288 | 0.1106 | 0.0092 |
| 5000000. | 50.00 | 30.0000 | 0.2582 | 0.2325 | 0.1122 | 0.0008 |
| 5000000. | 50.00 | 45.0000 | 0.2648 | 0.2397 | 0.1125 | -0.0051 |
| 5000000. | 50.00 | 60.0000 | 0.2732 | 0.2488 | 0.1127 | -0.0076 |
| 5000000. | 50.00 | 75.0000 | 0.2815 | 0.2574 | 0.1138 | -0.0069 |
| 5000000. | 50.00 | 90.0000 | 0.2878 | 0.2636 | 0.1154 | -0.0038 |
| 5000000. | 50.00 | 105.0000 | 0.2899 | 0.2653 | 0.1169 | 0.0012 |
| 5000000. | 50.00 | 120.0000 | 0.2869 | 0.2611 | 0.1187 | 0.0059 |
| 5000000. | 50.00 | 135.0000 | 0.2793 | 0.2518 | 0.1206 | 0.0076 |
| 5000000. | 50.00 | 150.0000 | 0.2699 | 0.2410 | 0.1216 | 0.0038 |
| 5000000. | 50.00 | 165.0000 | 0.2628 | 0.2337 | 0.1202 | -0.0049 |
| 5000000. | 50.00 | 180.0000 | 0.2605 | 0.2328 | 0.1159 | -0.0155 |
| 5000000. | 50.00 | 195.0000 | 0.2640 | 0.2390 | 0.1094 | -0.0251 |
| 5000000. | 50.00 | 210.0000 | 0.2726 | 0.2510 | 0.1018 | -0.0312 |
| 5000000. | 50.00 | 225.0000 | 0.2838 | 0.2660 | 0.0934 | -0.0324 |
| 5000000. | 50.00 | 240.0000 | 0.2945 | 0.2807 | 0.0846 | -0.0279 |
| 5000000. | 50.00 | 255.0000 | 0.3019 | 0.2915 | 0.0762 | -0.0176 |
| 5000000. | 50.00 | 270.0000 | 0.3036 | 0.2954 | 0.0701 | -0.0033 |
| 5000000. | 50.00 | 285.0000 | 0.2996 | 0.2915 | 0.0684 | 0.0121 |
| 5000000. | 50.00 | 300.0000 | 0.2908 | 0.2805 | 0.0722 | 0.0256 |
| 5000000. | 50.00 | 315.0000 | 0.2789 | 0.2650 | 0.0801 | 0.0334 |
| 5000000. | 50.00 | 330.0000 | 0.2672 | 0.2493 | 0.0900 | 0.0340 |
| 5000000. | 50.00 | 345.0000 | 0.2585 | 0.2369 | 0.0994 | 0.0285 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 5000000. | 60.00 | 0. | 0.2738 | 0.2605 | 0.0826 | 0.0175 |
| 5000000. | 60.00 | 15.0000 | 0.2740 | 0.2600 | 0.0861 | 0.0087 |
| 5000000. | 60.00 | 30.0000 | 0.2769 | 0.2629 | 0.0870 | 0.0007 |
| 5000000. | 60.00 | 45.0000 | 0.2821 | 0.2686 | 0.0861 | -0.0054 |
| 5000000. | 60.00 | 60.0000 | 0.2892 | 0.2765 | 0.0844 | -0.0090 |
| 5000000. | 60.00 | 75.0000 | 0.2970 | 0.2850 | 0.0831 | -0.0092 |
| 5000000. | 60.00 | 90.0000 | 0.3036 | 0.2920 | 0.0828 | -0.0062 |
| 5000000. | 60.00 | 105.0000 | 0.3067 | 0.2950 | 0.0840 | -0.0011 |
| 5000000. | 60.00 | 120.0000 | 0.3057 | 0.2931 | 0.0867 | 0.0038 |
| 5000000. | 60.00 | 135.0000 | 0.3009 | 0.2870 | 0.0903 | 0.0059 |
| 5000000. | 60.00 | 150.0000 | 0.2943 | 0.2790 | 0.0934 | 0.0033 |
| 5000000. | 60.00 | 165.0000 | 0.2887 | 0.2728 | 0.0942 | -0.0039 |
| 5000000. | 60.00 | 180.0000 | 0.2863 | 0.2709 | 0.0916 | -0.0133 |
| 5000000. | 60.00 | 195.0000 | 0.2881 | 0.2742 | 0.0856 | -0.0222 |
| 5000000. | 60.00 | 210.0000 | 0.2937 | 0.2821 | 0.0767 | -0.0279 |
| 5000000. | 60.00 | 225.0000 | 0.3012 | 0.2924 | 0.0664 | -0.0286 |
| 5000000. | 60.00 | 240.0000 | 0.3083 | 0.3022 | 0.0562 | -0.0234 |
| 5000000. | 60.00 | 255.0000 | 0.3123 | 0.3083 | 0.0481 | -0.0130 |
| 5000000. | 60.00 | 270.0000 | 0.3120 | 0.3089 | 0.0437 | 0.0001 |
| 5000000. | 60.00 | 285.0000 | 0.3079 | 0.3045 | 0.0438 | 0.0131 |
| 5000000. | 60.00 | 300.0000 | 0.3010 | 0.2961 | 0.0486 | 0.0240 |
| 5000000. | 60.00 | 315.0000 | 0.2921 | 0.2849 | 0.0570 | 0.0302 |
| 5000000. | 60.00 | 330.0000 | 0.2833 | 0.2736 | 0.0669 | 0.0305 |
| 5000000. | 60.00 | 345.0000 | 0.2768 | 0.2650 | 0.0759 | 0.0255 |
| 5000000. | 70.00 | 0. | 0.2898 | 0.2833 | 0.0588 | 0.0161 |
| 5000000. | 70.00 | 15.0000 | 0.2899 | 0.2830 | 0.0621 | 0.0088 |
| 5000000. | 70.00 | 30.0000 | 0.2917 | 0.2848 | 0.0628 | 0.0017 |
| 5000000. | 70.00 | 45.0000 | 0.2951 | 0.2886 | 0.0616 | -0.0043 |
| 5000000. | 70.00 | 60.0000 | 0.3000 | 0.2940 | 0.0590 | -0.0084 |
| 5000000. | 70.00 | 75.0000 | 0.3058 | 0.3004 | 0.0560 | -0.0097 |
| 5000000. | 70.00 | 90.0000 | 0.3111 | 0.3063 | 0.0538 | -0.0081 |
| 5000000. | 70.00 | 105.0000 | 0.3145 | 0.3099 | 0.0534 | -0.0044 |
| 5000000. | 70.00 | 120.0000 | 0.3152 | 0.3104 | 0.0551 | -0.0005 |
| 5000000. | 70.00 | 135.0000 | 0.3133 | 0.3079 | 0.0582 | 0.0013 |
| 5000000. | 70.00 | 150.0000 | 0.3100 | 0.3039 | 0.0613 | -0.0003 |
| 5000000. | 70.00 | 165.0000 | 0.3069 | 0.3004 | 0.0628 | -0.0052 |
| 5000000. | 70.00 | 180.0000 | 0.3054 | 0.2990 | 0.0612 | -0.0119 |
| 5000000. | 70.00 | 195.0000 | 0.3059 | 0.3002 | 0.0561 | -0.0183 |
| 5000000. | 70.00 | 210.0000 | 0.3082 | 0.3037 | 0.0481 | -0.0221 |
| 5000000. | 70.00 | 225.0000 | 0.3115 | 0.3083 | 0.0388 | -0.0218 |
| 5000000. | 70.00 | 240.0000 | 0.31[illegible] | 0.3125 | 0.0299 | -0.0169 |
| 5000000. | 70.00 | 255.0000 | 0.3157 | 0.3148 | 0.0235 | -0.0082 |
| 5000000. | 70.00 | 270.0000 | 0.3148 | 0.3140 | 0.0209 | 0.0026 |
| 5000000. | 70.00 | 285.0000 | 0.3115 | 0.3104 | 0.0224 | 0.0131 |
| 5000000. | 70.00 | 300.0000 | 0.3066 | 0.3046 | 0.0278 | 0.0215 |
| 5000000. | 70.00 | 315.0000 | 0.3009 | 0.2976 | 0.0358 | 0.0261 |
| 5000000. | 70.00 | 330.0000 | 0.2956 | 0.2910 | 0.0448 | 0.0262 |
| 5000000. | 70.00 | 345.0000 | 0.2917 | 0.2860 | 0.0529 | 0.0224 |

| H (feet) | THETA (degrees) | PHI (degrees) | B (oersteds) | Bz (oersteds) | By (oersteds) | Bx (oersteds) |
|---|---|---|---|---|---|---|
| 5000000. | 80.00 | 0. | 0.3030 | 0.3007 | 0.0344 | 0.0148 |
| 5000000. | 80.00 | 15.0000 | 0.3030 | 0.3005 | 0.0377 | 0.0095 |
| 5000000. | 80.00 | 30.0000 | 0.3039 | 0.3014 | 0.0389 | 0.0038 |
| 5000000. | 80.00 | 45.0000 | 0.3055 | 0.3031 | 0.0382 | -0.0013 |
| 5000000. | 80.00 | 60.0000 | 0.3078 | 0.3056 | 0.0362 | -0.0052 |
| 5000000. | 80.00 | 75.0000 | 0.3103 | 0.3084 | 0.0334 | -0.0075 |
| 5000000. | 80.00 | 90.0000 | 0.3128 | 0.3112 | 0.0307 | -0.0081 |
| 5000000. | 80.00 | 105.0000 | 0.3147 | 0.3133 | 0.0289 | -0.0073 |
| 5000000. | 80.00 | 120.0000 | 0.3158 | 0.3145 | 0.0282 | -0.0063 |
| 5000000. | 80.00 | 135.0000 | 0.3160 | 0.3147 | 0.0286 | -0.0059 |
| 5000000. | 80.00 | 150.0000 | 0.3157 | 0.3142 | 0.0290 | -0.0068 |
| 5000000. | 80.00 | 165.0000 | 0.3151 | 0.3136 | 0.0287 | -0.0090 |
| 5000000. | 80.00 | 180.0000 | 0.3146 | 0.3132 | 0.0268 | -0.0117 |
| 5000000. | 80.00 | 195.0000 | 0.3144 | 0.3133 | 0.0230 | -0.0140 |
| 5000000. | 80.00 | 210.0000 | 0.3146 | 0.3137 | 0.0177 | -0.0147 |
| 5000000. | 80.00 | 225.0000 | 0.3148 | 0.3143 | 0.0118 | -0.0131 |
| 5000000. | 80.00 | 240.0000 | 0.3149 | 0.3147 | 0.0066 | -0.0089 |
| 5000000. | 80.00 | 255.0000 | 0.3145 | 0.3145 | 0.0032 | -0.0027 |
| 5000000. | 80.00 | 270.0000 | 0.3135 | 0.3135 | 0.0025 | 0.0046 |
| 5000000. | 80.00 | 285.0000 | 0.3118 | 0.3116 | 0.0046 | 0.0118 |
| 5000000. | 80.00 | 300.0000 | 0.3097 | 0.3091 | 0.0093 | 0.0174 |
| 5000000. | 80.00 | 315.0000 | 0.3074 | 0.3063 | 0.0158 | 0.0207 |
| 5000000. | 80.00 | 330.0000 | 0.3053 | 0.3038 | 0.0228 | 0.0211 |
| 5000000. | 80.00 | 345.0000 | 0.3038 | 0.3018 | 0.0293 | 0.0189 |
| 5000000. | 90.00 | 0. | 0.3126 | 0.3122 | 0 | 0 |

Aeronautical Systems Division, Dir/Aeromechanics, Flight Control Lab, Wright-Patterson AFB, Ohio.
Rpt No. ASD-TDR-62-347. STOCHASTIC DISTURBANCE DATA FOR FLIGHT CONTROL SYSTEM ANALYSIS. Final report, Sept 62, 254p. incl illus., tables, 147 refs.

Unclassified Report

Disturbance data, together with guidance signals, are needed to perform realistic analyses of flight control systems. Stochastic disturbances, which are by definition defined only in a statistical sense, have not previously been compiled and codified for

( over )

use in such analyses. The stochastic data included in this report cover the subjects of winds, wind shear, gusts, magnetic fields, solar radiation, vibration and acoustics, meteors, thrust irregularities, and sensor noise. Areas of these subjects in which needed data are lacking have been exposed by the study. Present programs of data accumulation cited and the recommended new programs will produce significant information required to supplement the data of this report. A table of earth magnetic field intensities is included as an appendix.

1. Flight control systems
2. Turbulence
3. Meteorology
4. Magnetic fields
I. AFSC Project 8219, Task 821904
II. Contract AF 33 (616)-8088
III. Lockheed-Georgia Company, Marietta, Georgia
IV. John E. Hart, et al.
V. Aval fr OTS
VI. In ASTIA collection

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